SCIENTIFIC AMERICAN

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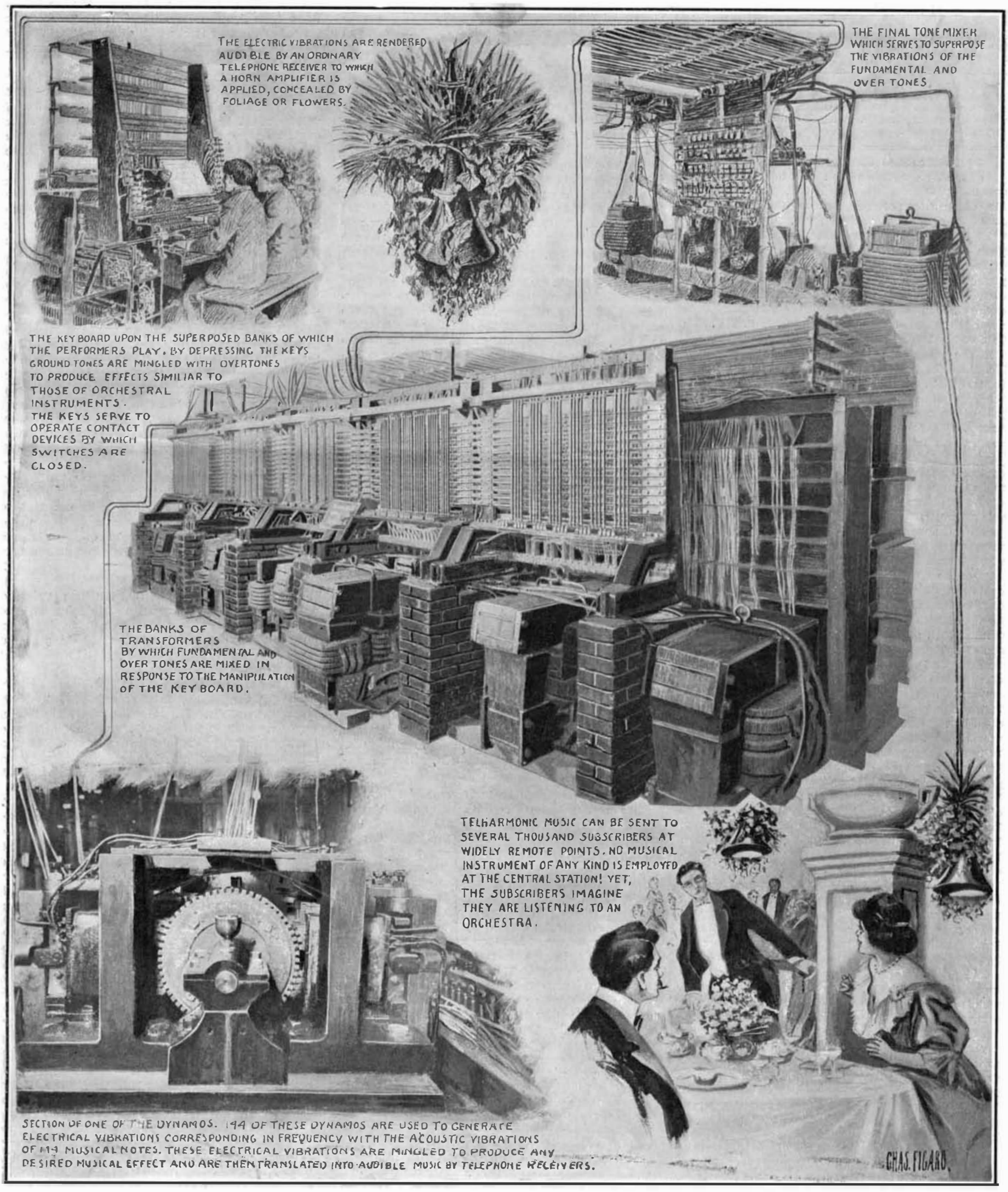
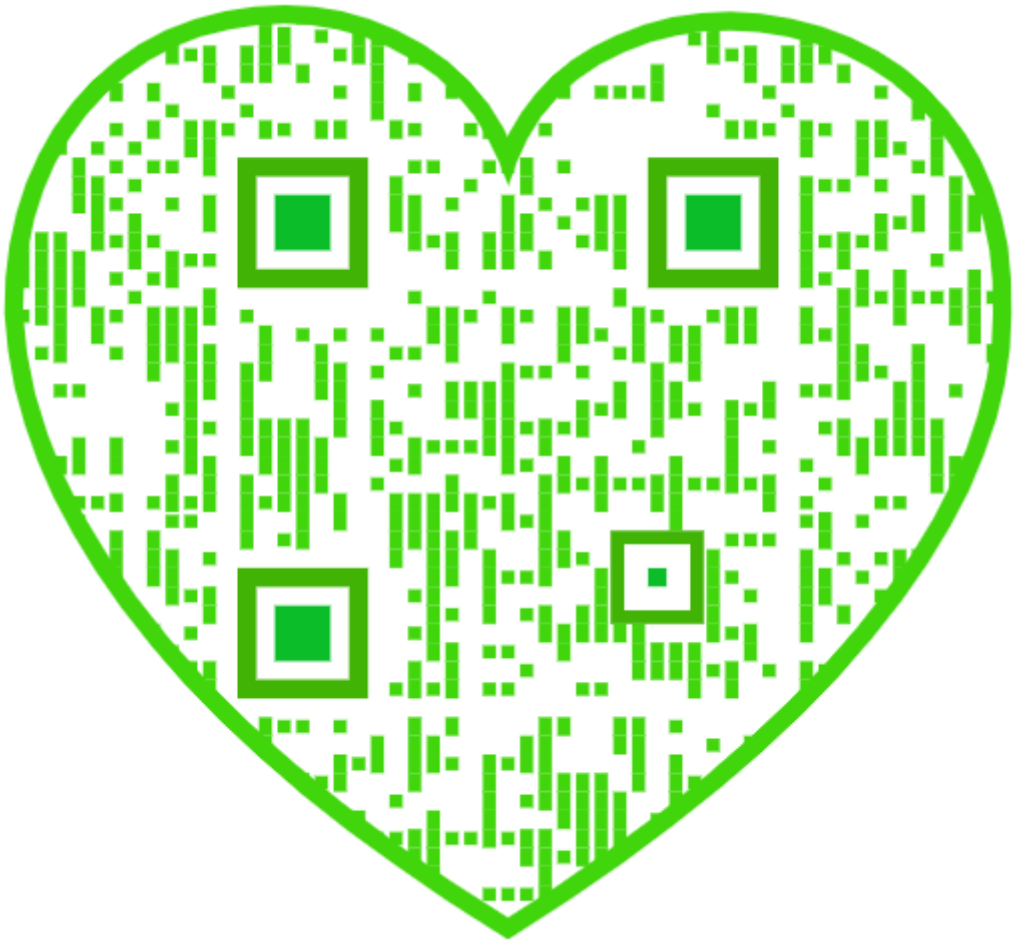

THE ELECTRIC VIBRATIONS ARE RENDERED AUDIBLE BY AN ORDINARY TELEPHONE RECEIVER TO WHICH A HORN AMPLIFIER IS APPLIED, CONCEALED BY FOLIAGE OR FLOWERS.
THE FINAL TONE MIXER WHICH SERVES TO SUPERPOSE THE VIBRATIONS OF THE FUNDAMENTAL AND OVER TONES.
THE KEY BOARD UPON THE SUPERPOSED BANKS OF WHICH THE PERFORMERS PLAY. BY DEPRESSING THE KEYS GROUND TONES ARE MINGLED WITH OVERTONES TO PRODUCE EFFECTS SIMILIAR TO THOSE OF ORCHESTRAL INSTRUMENTS. THE KEYS SERVE TO OPERATE CONTACT DEVICES BY WHICH SWITCHES ARE CLOSED.
THE BANKS OF TRANSFORMERS BY WHICH FUNDAMENTAL AND OVER TONES ARE MIXED IN RESPONSE TO THE MANIPULATION OF THE KEY BOARD.
TELHARMONIC MUSIC CAN BE SENT TO SEVERAL THOUSAND SUBSCRIBERS AT WIDELY REMOTE POINTS. NO MUSICAL INSTRUMENT OF ANY KIND IS EMPLOYED AT THE CENTRAL STATION! YET, THE SUBSCRIBERS IMAGINE THEY ARE LISTENING TO AN ORCHESTRA.
SECTION OF ONE OF THE DYNAMOS. 144 OF THESE DYNAMOS ARE USED TO GENERATE ELECTRICAL VIBRATIONS CORRESPONDING IN FREQUENCY WITH THE ACOUSTIC VIBRATIONS OF 144 MUSICAL NOTES. THESE ELECTRICAL VIBRATIONS ARE MINGLED TO PRODUCE ANY DESIRED MUSICAL EFFECT AND ARE THEN TRANSLATED INTO AUDIBLE MUSIC BY TELEPHONE RECEIVERS.
CHAS. FIGARO.

THE TELHARMONIUM—AN APPARATUS FOR THE ELECTRICAL GENERATION AND TRANSMISSION OF MUSIC.—[See page 210.



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ESTABLISHED 1845

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, MARCH 9, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ARMY ENGINEERS WILL BUILD PANAMA CANAL.

At the very time when the nation is looking for an announcement from Washington that the contract for the construction of the Panama Canal has been awarded, somebody, or something, gives a sudden twist to the kaleidoscope, the nation is informed that there is to be no contract, that another commission is to be formed, and that the building of the canal is placed in the hands of the army engineers. Simultaneously comes the startling announcement that the chief engineer, John Stevens, who not so very long ago went down to the Isthmus apparently in a "do or die" attitude of mind, has suddenly tendered his resignation.

At the present writing, the causes which prompted Mr. Stevens's desertion of this work, just when we all thought that he had perfected an organization and was ready to make some solid impression upon the vast job of excavation, have not been officially made known. We do not suppose it matters very much to the nation whether they are known or not. We could have wished, for the credit of the great body of civil engineers as a whole, that it had proved less difficult to find an engineer of prominence who had sufficient of the traditional professional spirit, to take hold of this great national work and see it through, with less concern for personal and private considerations and more concern for the prestige of the great nation which honors him by calling him to the work.

After the experience that has been had with civilian engineers, it is gratifying to realize that the control of the work has now been placed in the hands of military men, with whom there will be no thought of ever turning back until the job is completed. There is an end of resignations, once and for all; for the military man cannot desert the work if he would, and his pride of place is such that he would not if he could. The SCIENTIFIC AMERICAN is on record as believing that the best results would have been secured by letting the canal by contract under the supervision of a civil engineer of wide, practical experience, the advantage of letting by contract being that the large contractors know exactly where the right classes of labor and the particular force of skilled mechanics and foremen can be found; that they have the plant, or a large portion of it already in hand; and that they have back of them long years of experience in the handling of large bodies of men in the execution of works of magnitude. In professional ability, theoretical and executive, however, there is no finer body of engineers in the world than those of the army. Through all the many decades in which they have been planning and superintending the construction of great national works, there is scarcely an instance to be found of collusion between the engineer and the contractors, and these few cases have been visited with speedy and condign punishment. Under the army engineers, the work will be executed with the highest professional intelligence, with the thoroughness which characterizes all the army engineer's work, and with the most scrupulous fidelity in the handling of the national finances. That it may take somewhat longer than if it were executed under contract and civilian professional oversight is probable; but the nation may at least have the satisfaction of knowing that it has seen the last of these all too-frequent resignations and the frequent and demoralizing changes of base and policy which have so delayed the progress of the canal.

SIDE-DOOR CARS AND RAPID TRANSIT.

In providing the equipment for the New York Subway, there was one disastrous blunder committed, from which the system has suffered from the first day of its opening, and will continue to suffer as long as the present cars are in use. We refer to the adoption of the obsolete and altogether inefficient end-door car—absolutely the very worst type of car that could have been selected for expeditious loading and unloading of passengers. After building the roadbed of the most solid and expensive construction, equipping the cars with motors capable of giving the trains an acceleration of as high as 1.25 miles per hour per second, providing the most up-to-date system of signals, all with a view to securing high speed and handling the biggest number of people possible within the shortest time, the company have effectively undone much of this costly work of preparation by using a car which renders absolutely impossible the rapid unloading and loading of passengers. It is the long delays, due to the congestion at the doors of the cars at stations, and this alone, that prevents the Subway from a more expeditious handling of crowds during the rush hours of travel.

If some visiting engineer, let us say, from a distant planet, with intelligence to comprehend mundane affairs, were to be shown our Rapid Transit Subway, and have it explained to him that its ultimate object was to handle the greatest number of people in the least possible time, he would be moved to astonishment, if not to mirth and laughter, at the anomaly presented by the splendid speed between stations and the ridiculous and altogether unnecessary delay when the stations are reached.

The large sliding door at the center of each car, such as is used on the Brooklyn Bridge and the Boston Elevated Railways, is a partial solution; but the provision of a separate door opposite each pair of transverse seats is the only absolute solution. This system is indorsed by fifty years of satisfactory experience in heavy suburban travel in England and on the Continent. On the multiple side-door system, each door has to discharge only the few passengers seated on the pair of seats adjacent to it; and the writer has frequently seen a train load of a thousand commuters emptied onto the platform of a London station within a few seconds of the arrival of the train. That the side-door car is suited to American conditions has been proved by the success of some of this type that have been built for the Illinois Central Railroad. The sliding doors of the Illinois Central cars are operated by the guards; but an improvement on this method, designed to protect the passenger from injury, is to be adopted on the new tunnel cars to be used in the McAdoo system. All of these are to be provided with center doors; and both the end and center entrances are to be operated by compressed air under the control of the guards at the end of each car. The air pressure used to close the door will be just sufficient to bring it shut, but not sufficient to prevent a passenger stopping its progress temporarily, should he not be clear of the entrance. These tunnel cars will be a great advance upon those in use in the present Subway, particularly as they are to be used in conjunction with separate loading and unloading platforms; but we believe that the tunnel companies would add greatly to the carrying capacity of their new line in the rush hours, would they go one step further and adopt the system of separate side doors to each pair of seats.

GOVERNMENT TEST OF SUBMARINES.

At the last session of Congress an act was passed authorizing the Secretary of the Navy to contract and spend for submarine torpedo boats $1,000,000. A special naval board has been appointed for the purpose of handling the matter, and it has just completed the regulations to govern the comparative test of such vessels.

The trial course will be in Narragansett Bay, and will be one mile in length. The relative capacities and values of the competing vessels will be reached by comparative tests, as the board has decided that it will not be practicable to conduct all tests simultaneously. The speed trials will be made under three conditions of the contesting boats, viz., cruising, with all ballast tanks empty; vessels not showing more than half of the conning tower above water and ready for instant diving; and in submerged condition, with the top of the conning tower not less than ten feet below the surface and the top of the observation masts at least three feet above the surface. Three runs at maximum speed will first be required, to be followed by five or six runs back and forth at progressively reduced speeds, to be determined by the trial board. The board will take into consideration also the habitability of each vessel, its construction, condition, and outfit at trial, endurance, plans and specifications, strength and workmanship, mining, countermining, sea trial, and torpedo firing.

In the last named, the boat, carrying a full complement of torpedoes, must make a submerged run, during which she shall discharge at a suitable target about 300 feet in length. The first torpedo must be fired when the boat is at a distance of 2,500 yards from the target. Such reloading as may be necessary must be done while the vessel is submerged and under way. Observation of the target must be taken without coming to surface except in the case of the last torpedo fired.

NEW YORK CENTRAL SIX-TRACK SUBWAY.

The Rapid Transit Commission of this city and the New York Central Railway Company have come to an agreement as to the best disposition to be made of the freight tracks of the company which extend down the western shore line of Manhattan from Spuyten Duyvil and along Eleventh Avenue and West Street to the freight terminus on Beach Street. The railroad company has agreed to place its Eleventh Avenue line underground and has arranged to abolish every grade crossing along the North River water front from Spuyten Duyvil, at the mouth of the Harlem River, to Seventy-second Street, all to be done without expense to the city. In return for this concession, the Rapid Transit Commission has agreed to give the company a six-track subway in Eleventh Avenue in place of the two tracks it now operates on the surface, and to allow the company to operate six tracks along the Hudson River from Spuyten Duyvil to Seventy-second Street, instead of the four tracks which it now has. The subway will extend from Sixty-fifth Street south to Thirtieth Street.

Another most important question which is under investigation by the commission is the problem of traffic south of Thirtieth Street; and it is likely that this will be solved by the construction of a large elevated structure along the entire shore line between West Street and the water front which will be owned by the city and leased to such railroads as care to make use of it, connections being made to all piers and various warehouses. In its report upon the subject the committee points out that so many large problems affecting the lower section of Manhattan enter into the planning of this structure that further time must be given for its consideration before a final report is made.

BRIDGING THE HUDSON RIVER.

It is merely a question of time and money when the long-talked-of project of throwing a bridge across the Hudson River between New York and New Jersey will be an accomplished fact; for the necessity of this bridge has long existed and becomes more pressing with the passing years. It is true that the urgency for a steam railroad bridge disappeared, or rather was temporarily relieved, when the Pennsylvania Railroad Company and the Hudson Companies began the construction of their six tunnels below the river. These tunnels, however, will provide passage for steam railroads only—or, to be more accurate, for electric railroad traffic. They make no provision whatever for the vast amount of vehicular traffic which now crosses by way of the ferry boats between the opposite shores of the river. This class of traffic grows larger every year, and particularly during the past decade has it been increased by the introduction of the automobile and the desire of its owners to have access to the splendid highway system of New Jersey.

In recognition of the fact that the time is ripe for once more agitating the question of bridging the Hudson, and that a work of this magnitude, being too onerous for private enterprise, could best be put through by the two States that would be benefited, a committee was appointed to investigate the question, select a site or sites, and determine the scope of the enterprise, the distribution of responsibilities, and the best means of financing it. This committee has recently reported to the legislature under the name of the New York Interstate Bridge Commission. It recommends the construction of three bridges, one across the Hudson at some location between 14th and 72d Streets, and two others to span the Kills which flow between Staten Island and New Jersey. The commission believes that the expense should be borne either equally or in just proportion by the States of New York and New Jersey. It further recommends that in view of the large space needed for terminals, if they were to include transcontinental trunk lines and passenger and freight traffic, the bridge should be designed primarily for vehicles, foot passengers, and trolley lines, the trolley lines to include, however, a high-power line crossing and connecting with all the trunk lines in New Jersey. It is estimated that the cost of the main Hudson River bridge would be not less than $25,000,000 and might easily run to $35,000,000; but we are of the opinion that these figures are much too low and that a bridge of this magnitude could scarcely be built for less than $45,000,000. The cost of the two bridges connecting Staten Island with the mainland would be about $500,000 each.

An American company is building for the Mexican Central Railroad a number of oil-burning freight engines of an unusual type. They are eight-coupled engines with a leading pony truck. The boiler has 2,168 square feet of heating surface. The total weight available for adhesion is about 110 tons, the ratio of tractive effort to adhesive weight being 1 to 4¾. A boiler pressure of 200 pounds to the square inch is used. The fuel is crude petroleum, which is vaporized by a steam jet, and deflected against a soapstone arch in the firebox.

ORSON DESAIX MUNN.

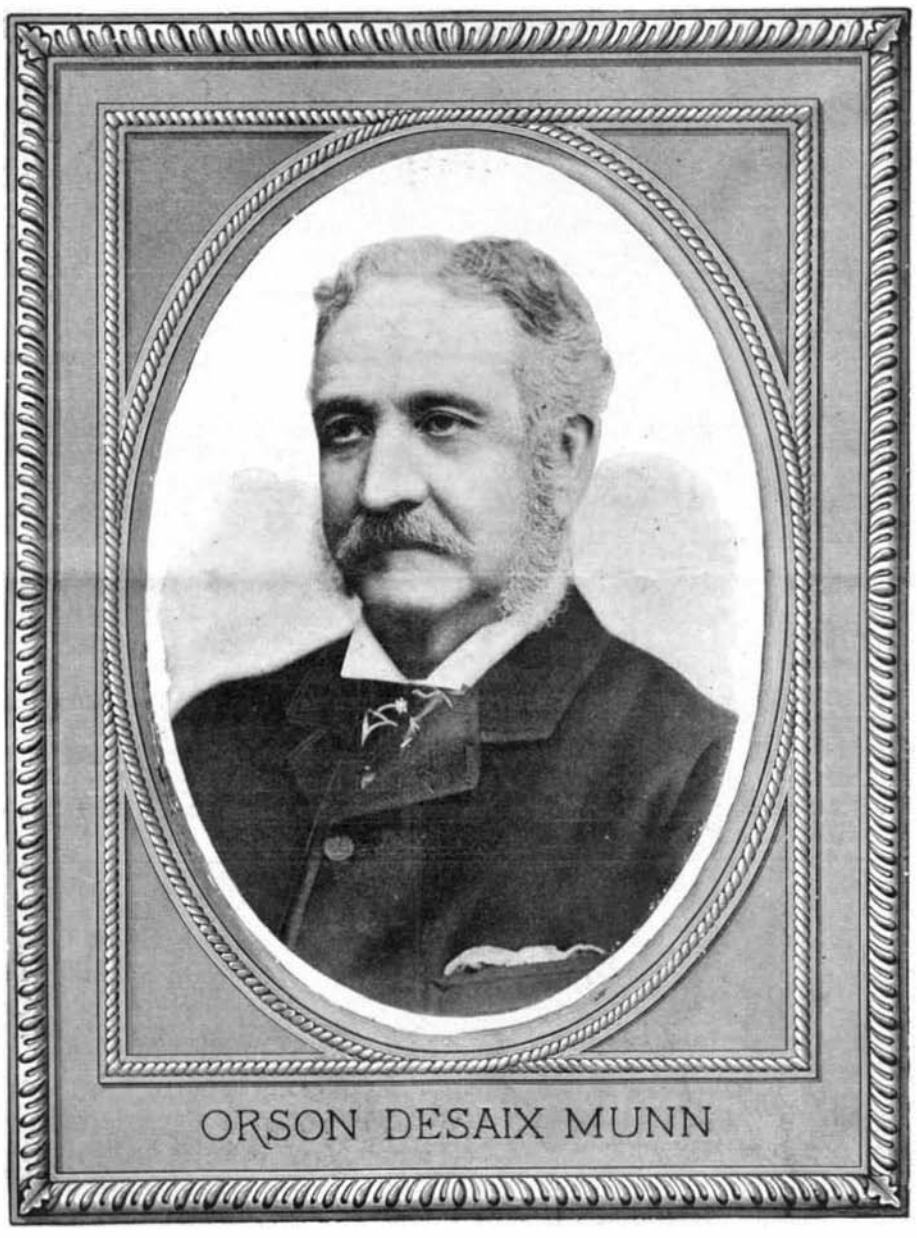
With the death of Mr. Orson Desaix Munn, there has passed from our midst the last of the two original founders of the SCIENTIFIC AMERICAN. For an unbroken period of sixty-two years this journal was the object of the earnest zeal and close attention of a life which, before its close, had stretched far beyond the allotted three-score years and ten. His associates recall with mournful interest that Mr. Munn was at his desk as recently as February 15—the day preceding the slight stroke of paralysis which, in spite of a rally which gave hopes of his recovery, resulted in his decease in the evening of February 28, in the eighty-third year of his age. Like his partner, the late Alfred Ely Beach, whose death was recorded in these columns a little over eleven years ago, Mr. Munn gave the whole of his attention to the interests of this journal.

It was fitting that one whose name was to be so intimately associated with the work of fostering and chronicling the scientific and industrial development of his country during the most notable period of its growth, should come of good American stock, whose foundations were laid in the stirring days of the early New England settlers. The first direct ancestor of the deceased who settled in America was Benjamin Munn, who in 1637 removed from Hartford, Conn., to Springfield, Mass., and subsequently was an active participant in the Pequot war, having served under the leadership of Capt. John Mason. From him was descended Reuben Munn, who raised a company and marched to Cambridge at the time of the Lexington alarm call. He served under Gates during the campaign resulting in the surrender of Burgoyne, and finally attained the rank of lieutenant colonel. Rice Munn, who was born in 1776 and died in 1866, was the father of the subject of the present memorial, and is described as exemplifying the sterling qualities of the Puritan stock from which he was descended—upright and honest in his dealings, a true friend, a good father and husband, and a man of more than average ability. He married Lavinia Shaw, and Orson Desaix Munn, the youngest son of that union, was born in Monson, Mass., June 11, 1824.

He was educated at Monson Academy, and after a brief business experience in his native town, young Munn in the year 1846, was induced by his former schoolmate, Alfred Ely Beach, to take a step which determined both his future life residence and his future life work. Young Mr. Beach, who was employed on the staff of the New York Sun, at that time owned by his father, Moses Y. Beach, had learned that a publication known as the SCIENTIFIC AMERICAN was for sale, and asked Mr. Munn to join him in the purchase of the property. A partnership was formed, and the firm of Munn & Co. established. An office was taken in the old Sun building at the corner of Fulton and Nassau Streets, and the knowledge and advice secured by such close association with the great daily proved invaluable to the young editors and publishers. The first issue under the new firm appeared on July 23, 1846.

In a period when the SCIENTIFIC AMERICAN was the only journal in the United States devoted purely to science and mechanics, it was inevitable that its editors should be brought into touch with the inventors of the day, and one of the most frequent callers was Elias Howe of sewing machine fame. This intercourse naturally led to the establishment of a patent department. The announcement of this policy, coming at a time when the profession of the patent lawyer was practically unknown, met with immediate response, and marked the auspicious beginning of a practice which speedily necessitated the opening of a Washington office, and ultimately grew to be the largest of the kind in existence. The offices of the journal soon became the center for the gathering of the most noted inventors of the day, and here the editors were in constant intercourse with such men as Capt. John Ericsson, Commodore Edwin A. Stevens, Capt. James B. Eads, and Samuel F. B. Morse. Judge Mason, a Commissioner of Patents of those days, on his retirement from the Patent Office, became associated with Munn & Co. in their patent department. He was an able man, very popular with inventors, who achieved a notable success in fighting to a successful issue the extension of the Morse telegraph patents. Apart from the fact that the department thus inaugurated in the sixty years of its life has been concerned in the securing of over 100,000 patents, it has formed the school in which some of the most noted patent lawyers of the day received their first training.

The next important step in the history of the firm was the publication of the SCIENTIFIC AMERICAN SUPPLEMENT, whose *raison d'etre* was found in the wish to describe and illustrate the mass of interesting exhibits at the Centennial Exposition of 1876. The success of the venture led to the decision to continue the publication as a weekly review of the scientific literature of the day, in which might be included articles too long or strictly technical for the more popular tastes of the readers of the parent paper. This was followed a few years later by the publication of LA AMERICA CIENTIFICA, designed to place the various Spanish-speaking races of South America in touch with the progress of science and the arts in the sister northern republic. In 1885 the firm decided that, in view of the large number of requests for information on the subject of house building and furnishing and kindred subjects, the time was ripe for launching a monthly journal, covering this field, and the first issue of the Building Edition of the SCIENTIFIC AMERICAN made its appearance accordingly. The success of this venture justified the enlargement of the scope of the publication, and in 1905 it was remodeled and published in a new form under its present name of AMERICAN HOMES AND GARDENS.



ORSON DESAIX MUNN

We have given this somewhat detailed sketch of the growth of the enterprise that was started so modestly some sixty years ago, for the reason that the history of the firm is the history of the business life of the late editor and proprietor. It was during the long and cordial co-operation of the ever-growing staff of employees that the latter learned to look upon Mr. Munn with warm regard and affection; and to this attitude of personal interest, sympathy, and confidence, shown by both members of the firm, is to be attributed the unusually protracted tenure of position by a large portion of the present staff, whose term of service has, in some cases, covered between thirty and forty years.

The keynote to the character of the deceased was his benevolent optimism. Although, when occasion required, he could act with all the stern sense of justice and righteous indignation of his New England ancestry, he was essentially and by choice kind and gentle—as keen in his sympathy with the unfortunate and suffering as he was strong in his dislike of all the forms and instruments of violence. His works of philanthropy, public and private, have endeared his name to the many who were the objects of his generous and unostentatious benevolence. His chosen means of recreation showed his tastes to be essentially those of a country gentleman. His winters were spent in his town house in East Twenty-second Street, where he had lived continuously for over fifty years; but he always welcomed the coming of spring and the opportunity to return in the early summer to his charming country home, "The Terraces," in Llewellyn Park, Orange, N. J.

The deceased was one of the oldest members of the Union Club and a civil war member of the Union League Club, both of this city. He belonged also to the Merchants' and Essex County Country Clubs, the New England Society, and the Sons of the Revolution.

In 1849 Mr. Munn married Julia Augusta Allen. She died on October 26, 1894. The surviving son, Charles Allen Munn, and Frederick Converse Beach, son of the late Alfred Ely Beach, are the leading spirits in the present company. An elder son, Henry Norcross Munn, died a few years ago. His son, who has just begun his career in the SCIENTIFIC AMERICAN office, will preserve the name which has been so long associated with this publication, as he bears the name of his grandfather, Orson Desaix Munn.

KITES IN LIFE-SAVING OPERATIONS.

The use of kites in life-saving operations at sea is attracting some attention in France, and a new system consists in the combination of kites and an improved floating device known as "deviator." Such a system has been brought out quite recently by M. Jansen, and a series of trials with the apparatus, which were very successful, was made in the last week of February. The trials took place at Royan, on the coast of France, between the shore and vessels, and they were made in the following way: The steamer "Yvonne," gaging 300 tons, belonging to the Société Centrale de Sauvetage, was employed in the maneuvers, and the object was to carry a tow-line to it from the outer end of the Royan jetty. During the tests the steamer was constantly anchored at about 2,000 feet to the west of the fixed point whence started the "deviators" carrying the tow-line. The wind was very strong and blew from north-northwest to northwest one-fourth west. Owing to these conditions it was quite impossible to make connection from the shore to the boat by the use of a kite alone.

As regards the kite which was let up and was fixed to the float, or deviator, so as to tow it, this is of the Hargrave pattern of the two-cell type. Attached to the deviator, it underwent on the part of the latter a tractive effort such that the ensemble of the system succeeded in deviating from the direction of the wind by angles which varied between 60 and 70 degrees, according to the needs of the maneuver. At the end of the operation the deviator arrived at the point where the vessel was lying, and the line connecting the float to the kite covered the rigging of the ship and was caught in the latter. In the evolutions made by M. Jansen's new deviator, what is to be noticed outside of the surety of direction is the rapidity with which it makes its movement. Thus it required only four minutes, chronometered by the officers delegated by the Life Saving Society, for the deviator to cover the 500 meters separating the jetty from the vessel, given a speed of wind which exceeded 35 meters per second. In the experiments the apparatus was handled by two members of the Société Français de Navigation Aerienne, M. Jansen, the inventor, who looked after the regulation and trajectory of the float, and M. Varilles, who steered the Hargrave kite.

The German exports of iron and steel last year represent a total of 3,666,278 tons, against 3,358,420 in 1905, an increase of 307,854 tons, or 9 per cent. The excess of exports over imports amounted to 2,976,198 tons, against 2,981,425, a decrease of 5,227 tons, or 0.2 per cent.

A HIGH-SPEED BAVARIAN LOCOMOTIVE.

BY WILLIAM MAYNER.

The locomotive illustrated herewith was exhibited at Nürnberg; it was designed expressly for a normal speed of 94 miles an hour. Judging from the previous results obtained with the remarkable locomotives of the same builder, J. A. Maffei, of Munich, it is highly probable that this speed can be maintained and exceeded in practical trials. It is quite another matter, however, whether Bavarian State Railways are suited for such abnormal velocities in ordinary service. Were this so, we should have long since heard of extraordinarily high speeds in the south and west German states. Already speeds of 90 miles per hour with a train of 138 tons (car load) have been attained, on a slightly rising gradient, by Maffei "Atlantic" type locomotives that were built for maximum speeds of only 75 miles per hour. Such engines were not in the high-speed steam locomotive trials of March, 1904, but they exceeded for speed and tractive power the results obtained from other engines on the special Marienfelde to Zossen line, and, in fact, accomplished some of the fastest runs that had been made in Europe up to that period. The new engines resemble somewhat the 4—4—6 Thuile locomotive of 1900. All the constructive details are very fine; the work, in fact, approaches as near to motor-car practice as is permissible in railway engines.

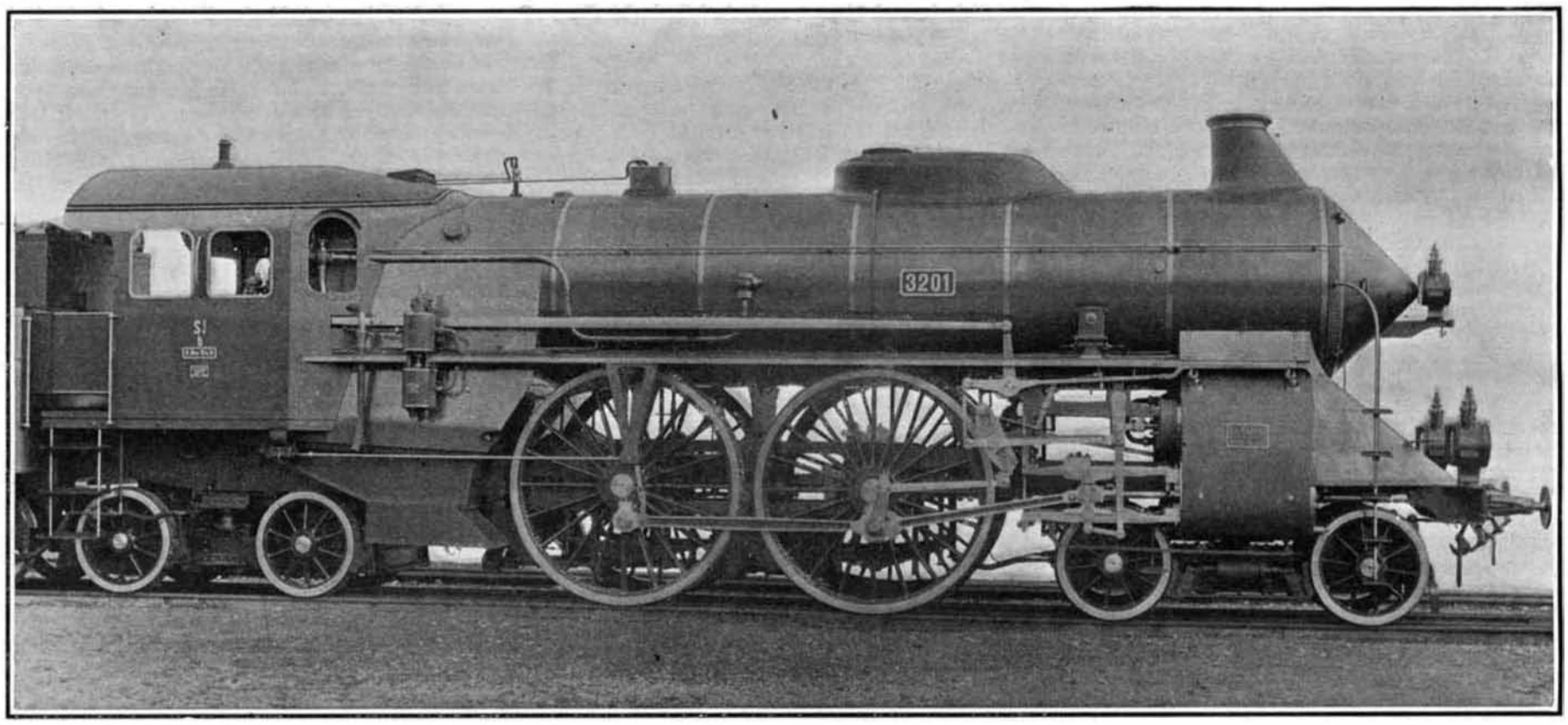
The new high-speed engine has four cylinders, compound, with the low-pressure outside as usual, and all bolted together in one transverse line. There is one driving axle only, and the driving mechanism is nearly perfectly balanced. The small counterweights in the driving and coupled wheels show to what extent the revolving masses have been made self-balancing. The fine proportions of the driving and coupling rods contribute to the elimination of disturbing forces.

The piston valves are of large size, and have the great length usual with double-ported distributors. At each end of the low-pressure valves are two small cylindrical valves connected with the expansion gear, and these open when the cut-off exceeds 70 per cent of piston stroke, as in starting, and thus admit high-pressure steam to the low-pressure valve chests until the engine has been geared up to less than 70 per cent. There is one set only of valve gears for four valves, and no intercepting valve is introduced.

Bar frames have been employed for reasons of economy in weight. Incidentally these frames permit of ready access to all working parts placed between them. Even the coupling rod on the opposite side of the engine is also discernible through the driving wheels.

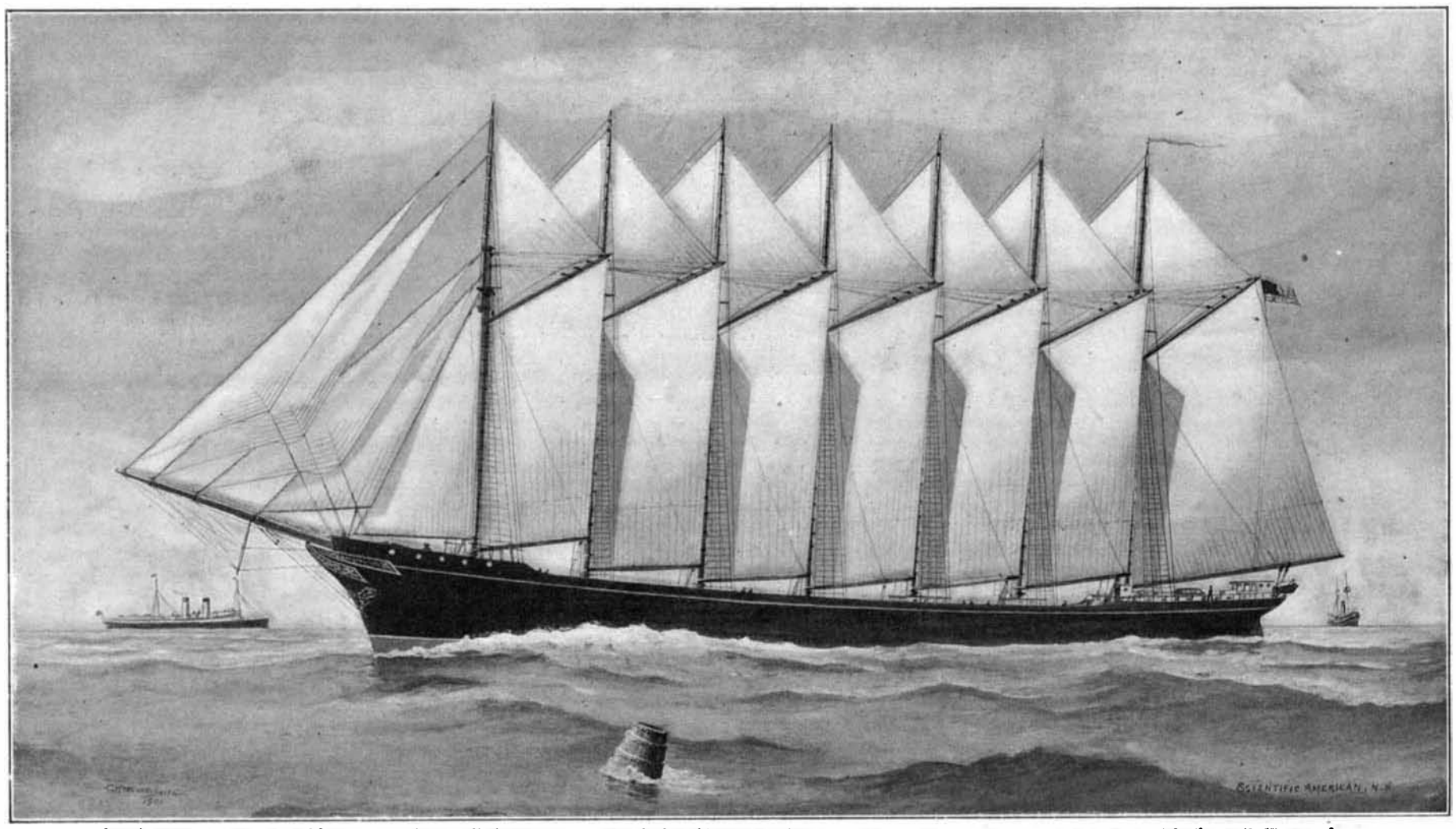
All parts of the engine presenting broad surfaces at right angles to the engine have been clothed in such way that they cleave the air, and reduce the head resistance when traveling at high speed. Careful experiments on the Continent and elsewhere have proved the real saving of power thus realized. It may be added here that the engine is of great length—45 feet 2 inches—with a height to the boiler center of about 9 feet, and a total height of 15 feet.

The high-pressure cylinders have a greater volume than those of any other European locomotive, including the new Belgian engines, but the boiler pressure of the 4—4—4 engines has been reduced to 30 pounds less than that of the most recent saturated-steam locomo-



A NEW HIGH-SPEED BAVARIAN LOCOMOTIVE.

Cylinders, high-pressure and low-pressure, respectively, 16½ inches and 24 inches by 25⅝ inches; driving wheels, diameter, 7 feet 5⅝ inches; boiler, internal diameter, 5 feet 6⅞ inches; total heating surface, 2,717 square feet; grate area, 50.5 square feet; boiler pressure, 205.8 pounds; total weight of engine, 92.5 tons; wheel base of engine, 38 feet 4½ inches; total length of engine and tender, 69 feet 4 inches; capacity of tender, 8.8 tons of coal and 5,730 gallons of water.



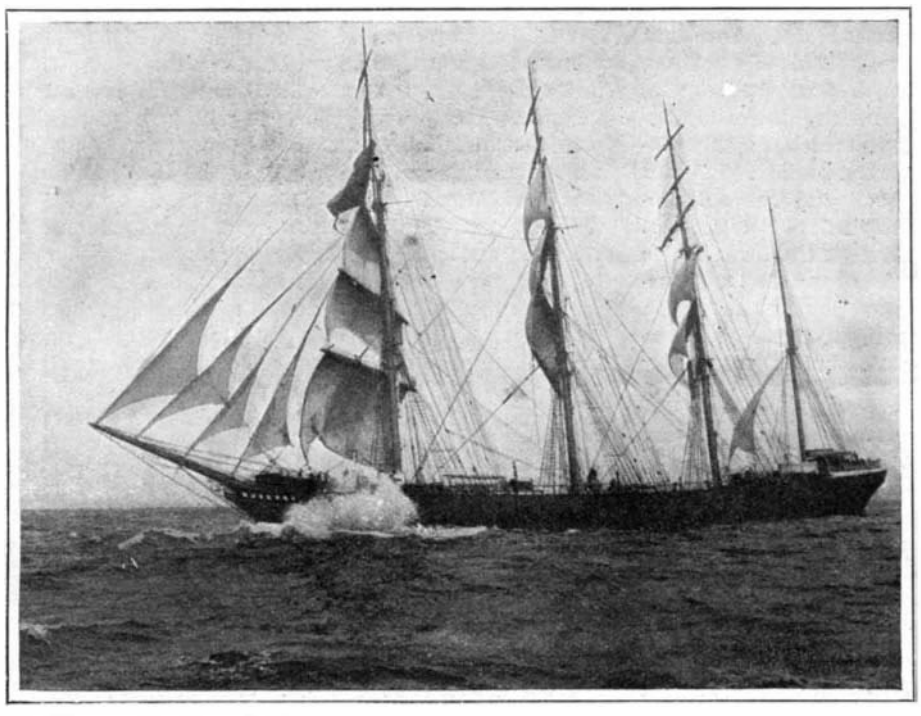
Length over all, 395 feet; molded depth, 34 feet 5 inches; displacement, 10,000 tons; deadweight cargo capacity, 7,500 tons; height mainmast, step to truck, 182 feet; total sail area, 40,617 square feet.

The Seven-Masted Steel Schooner "Thomas W. Lawson." A Type of Vessel Which Has Displaced the Square-Rigged Ship.

THE PASSING OF AMERICAN SQUARE-RIGGED VESSELS.

tives of the Bavarian railways. The ratio of volumes, high-pressure to low-pressure cylinders, has, at the same time, been decreased. The driving wheels are the largest that have yet been employed for four-cylinder compounds on the European continent. The principal object in the design is high speed with a light load, for which the 32 tons maximum adhesive power will be fully adequate. Compounding and superheating are introduced as contributing to this end, while the total mechanical efficiency is increased at the cost of some few tons of weight extra, which has, in large part, been compensated for in the general design of the locomotive.

This engine, the first of a new series, was designed and built by the firm of J. A. Maffei at the English Garden Works, near Munich.



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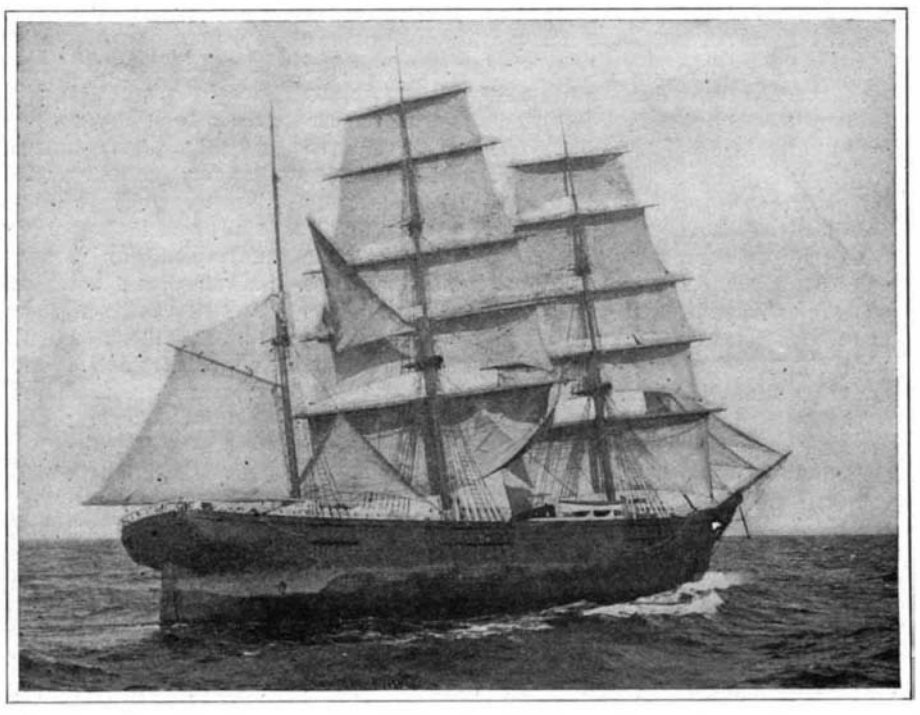
The English Ship "Muskoka," One of the Types of Vessel Charged with Running the Regulation Square-Rigger Out of Business.



The Bark "Coloma." A Type Which Made Its Appearance Many Years Ago, and May be Considered a Forerunner of the Modern Sailing Freighter.

THE PASSING OF AMERICAN SQUARE-RIGGED VESSELS.

BY JAMES J. M'CURDY.

That the American square-rigged sailing vessel is being gradually forced from the ocean highways, where it was long an important factor in the world's carrying trade, has been apparent for some time to those well versed in maritime affairs. That the conditions which have brought about this result were likely to continue, thus rendering the future of this portion of our deep-sea merchant marine one of extreme uncertainty, was also quite well understood.

Yet few have realized that the outlook for vessels of this type is as serious as has been set forth by the Commissioner of Navigation in his last annual report, lately from the press.

Under the caption "Decline in American Square-rigged Shipping," the commissioner discusses the situation at some length, and places himself on record as of the opinion that the existence of our square-rigged fleet cannot under present conditions extend beyond the period of twenty years. The statistics submitted in support of this estimate seem logical and convincing.

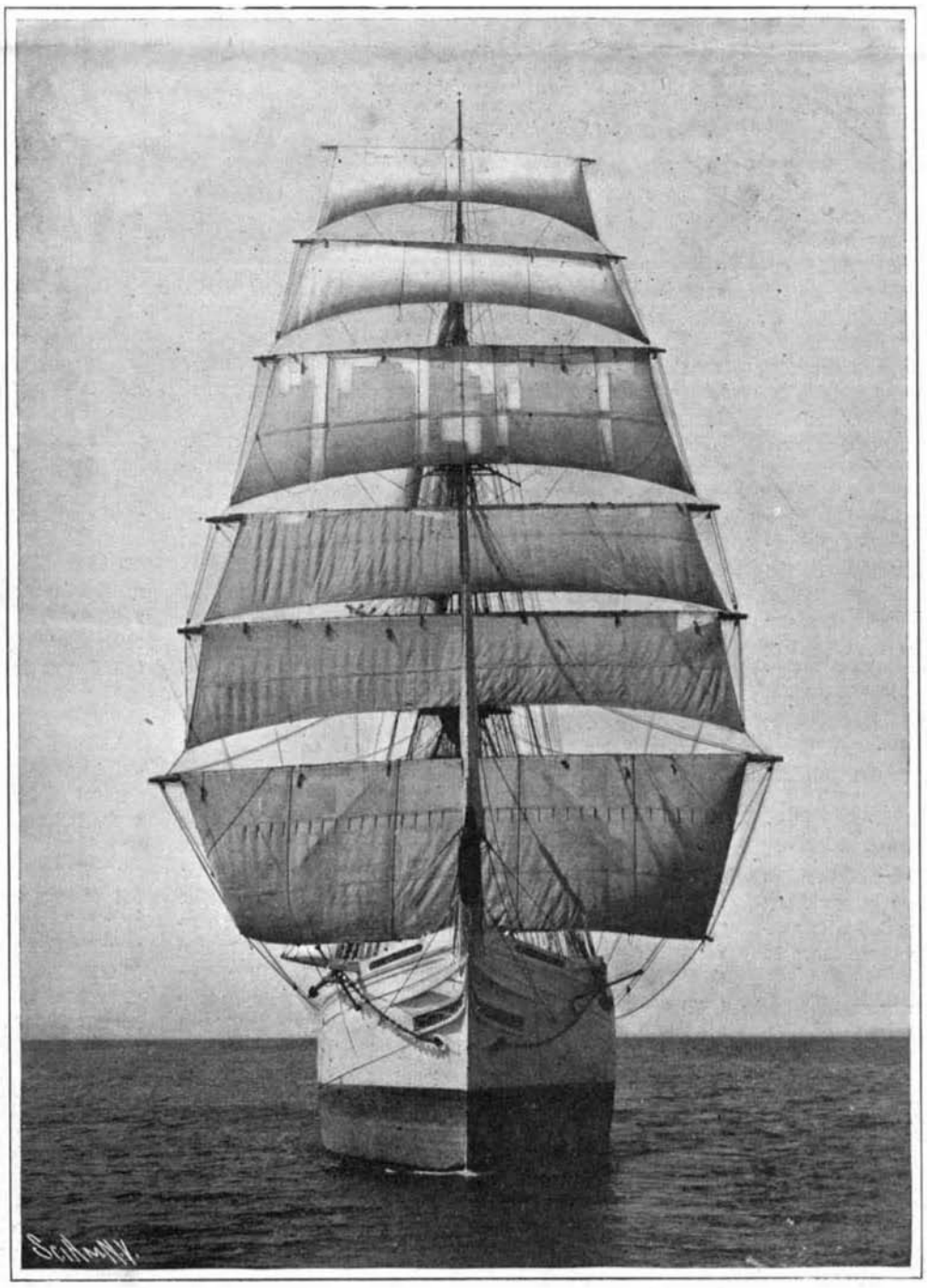
On June 30, 1894, there were 633 square-rigged vessels flying the stars and stripes. By June 30, 1904, the number had diminished to 322, a decrease of 311, or 49+ per cent. This, too, in face of the fact that by the annexation of Hawaii, 18 fine square-riggers were added to our merchant marine.

A second consecutive year has passed without the building of even one square-rigged vessel in the United States, something never heard of before. As the commissioner tersely expresses it, "the construction of square-rigged vessels has probably not entirely ceased in the United States, but the future output will not equal the loss through wreck, abandonment, and cutting down into barges."

The history of the square-rigger is inseparably interwoven with that of our country, and those who are conversant with the career of this type of vessel, will view its retirement with feelings of genuine regret. Authorities all agree that it was the handsomest rig of vessel that has ever engaged in traffic upon the ocean. There was beauty in every curve of the famous clippers that sped across the deep, and long before the era of arrogant steam, they had carried our flag to every seaport of the globe, and had given us a standing among the nations of the world.

Sentimental reasons do not alone enter into the feelings of regret that the rapid disappearance of these vessels excites. Originally the craft "which drew the world together and spread the race apart," they developed a type of seamen such as the world had never seen, and which can never be duplicated under steam navigation.

Those competent to express an opinion, hold that there would be a serious national loss to safe navigation if the square-rigged fleet were allowed to die out as rapidly as it seems destined to do under prevailing conditions. The time will doubtless come when ship training will not be deemed essential to the successful navigation of an ocean steamer; but at the present moment many cling to the idea that those in command of steamships should have had preliminary schooling on a square-rigger. In other countries, notably Germany, large steamship corporations keep in reserve sailing vessels, where the future officers of their steam fleets can receive training.



Barkentine "Makeweli"—a Cross Between a Ship and a Schooner.

It is quite the fashion at the present time to place the responsibility for the decadence of American sailing vessels entirely upon the foreign ships that have entered into competition with them; but this is only half a truth. It is a well-known fact that these foreign ships can be operated much more cheaply than ours. Then, too, some are helped by government bounties, as for instance the French vessels, which can sail around the world in ballast and still make a profit. Vessels of this character, placed in competition with ours, necessarily tend to depress freight rates, and likewise secure considerable business that would otherwise go to American vessels. But the fact remains that the foreign square-riggers are having almost as keen a struggle for existence as our own. When foreign shipowners allow fine large vessels to lie idle month after month in American ports, rather than attempt to run them at the ruinous rates that have prevailed for the past few years, it proves conclusively that the foreign owner of sail tonnage is not receiving much in the way of profits. Many foreign vessels, in the endeavor to keep in commission, have left Puget Sound ports with every cent of freight money drawn in advance and expended for loading and port charges, with the discharging expenses a dead loss to be borne at their journey's end. It was the foreign owners of sail tonnage that entered into an agreement not to accept charters below a certain figure, a movement that has had a tendency to improve rates, but to which American vessels have

lent no assistance whatever. Steam tonnage and vessels of the schooner type are largely accountable for the retirement of the square-rigger, whether it be American or foreign-built. The advantages of steam need no enumeration here. Schooners have many points of superiority over the square-rigger. They make quick passages, are good carriers, and can take on large deck-loads. They require but half as many men as a ship-rigged craft, as their sails can all be handled from the deck, and mostly with steam power.

Upon the Pacific coast the schooner is no longer merely a coaster, but has invaded the field formerly held by the square-rigger. We find them taking cargoes to China, Japan, Australia, South Africa, and even to Atlantic ports. As they can run so economically, they can make a profit on charters that would mean a dead loss to a ship.

As the schooner can do the work of a square-rigger, and do it at less expense, it stands to reason that those wishing to increase their sail property will build fore-and-afters instead of barks or ships. In like manner, later on, if conditions justify, they will build steamers in place of schooners.

The firm of Arthur Sewall, of Bath, Me., have endeavored for years to keep a fleet of square-riggers on the high seas, but now, after building ships since 1823, have announced that they will build no more. To-day, their fleet flag, which has been a familiar sight in all the great ports of the world for the last three-quarters of a century, is rapidly disappearing, even as their great shipbuilding plant is rusting to decay.

About sixteen years ago the Sewalls projected a fleet of fine ships, to bear the names of southern rivers. The "Rappahannock" was the first constructed, followed by the "Susquehanna," "Shenandoah," and "Roanoke," ranging in size from 2,700 to 3,500 gross tons. Misfortune followed in their wakes, and of these fine ships, only the "Shenandoah" remains. They made but little money for their owners, but demonstrated conclusively that under present conditions to build more vessels of their kind would be folly.

The practice of dismantling old ships and turning them into towing barges has been in vogue for some time, but converting stanch square-riggers into schooners is a somewhat new idea. Nevertheless, it has been done in several instances upon the Pacific coast with perfect success, and bids fair to become a general custom. Recently the "Snow and Burgess," an old State of Maine bark, was transformed into a five-masted schooner and has been beating all her previous records, besides cutting down her running expenses and increasing her carrying capacity. The old ship "Invincible," built in Bath in 1873, has also been converted into a schooner, and is again in commission after having been laid up for an indefinite period.

Of the 298 square-riggers in commission June 30, 1905, a large majority are in the hands of western owners, and are operating upon the Pacific coast. The lumber trade of the Pacific Northwest offered some inducements to these vessels, and some years ago a general exodus took place from the congested Atlantic ports to the Pacific, where ready employment was found as lumber carriers.

But now the time has come when even this trade is being rapidly absorbed by steamers and schooners, and to-day a number of these fine old vessels are loading cargo for Atlantic ports, to be dismantled upon arrival at their destinations, not many miles from where they entered upon their careers years ago. Dismantling, or conversion into schooners—such seems the fate of the remainder of the square-rigger fleet.

It is doubtful if any plan could be devised whereby the decadence of these vessels could be stayed. Any scheme of subsidy that could be enacted would apply to other forms of carriers as well, and would not tend to lessen the handicap under which ships are laboring. Nor does it seem probable that circumstances will so adjust themselves as to bring about a revival of this class of shipping.

The square-rigger has fulfilled its mission in the world's transportation system, and like the canoe of the trader on inland waters, or the ox-team of the pioneer upon land, it seems destined to pass into history as one of the utilities that was good enough in its generation, but must now be superseded by those more in keeping with modern requirements.

An aerial screw propeller working on a novel system has been invented by Major Hoernes, an aeronaut, says the Cologne Gazette. In his new contrivance the inventor takes advantage of the fact that the screw to be used in air has a wholly different medium to encounter than the ship's propeller, working in water, since air is capable of compression. He has, therefore, made use of a screw which is driven in a series of impulses, and not at one continuous speed, as is usually the case. He effects this by means of a system of screws, which not only revolve round their own axes, but also rotate round a common axis, planet fashion. The screw is thus driven alternately fast and slow.

THE TELHARMONIUM—AN APPARATUS FOR THE ELECTRICAL GENERATION AND TRANSMISSION OF MUSIC.

Dr. Thaddeus Cahill's system of generating music at a central station in the form of electrical oscillations, and of transmitting these oscillations by means of wires to any desired point, where they are rendered audible by means of an ordinary telephone receiver or a speaking arc, is now embodied in a working plant situated in the heart of New York. Although this apparatus constitutes but a portion of a plant that may ultimately assume very remarkable dimensions, and although it has limitations imposed by its size, the results obtained are so promising, that many applications have been made by prospective subscribers for connection with the central station. When a larger number of generators and keyboards is installed, as they doubtless will be in due time, there is no reason why the telharmonium, as the invention is called, should not give the subscribers all the pleasures of a full symphony orchestra whenever they wish to enjoy them. At present very beautiful effects are secured on a less elaborate scale, but in every way comparable with those of a good quintet. And several additional keyboards now in building at Dr. Cahill's works at Holyoke, Mass., where the New York plant was built, are nearing completion, and will probably be in service at Broadway and Thirty-ninth Street in the course of another month or two.

Perhaps the feature which most astonishes the technically uninformed man when Dr. Cahill's invention is first exhibited to him is the fact that music in the ordinary sense of the word, in other words, rhythmic vibrations of the air, is not produced at the central station. The vibrant notes of the flute, mingled with the clarinet or viol-like tones which are heard at the receiving end of the wire, spring from no musical instrument whatever. Nowhere is anything like a telephone transmitter used, although the electrical oscillations which are sent to the receiver and there

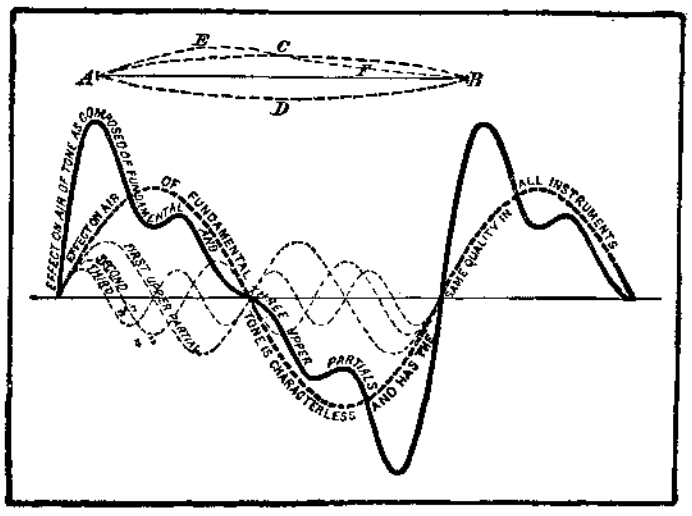


Diagram Showing Effect of the Upper Partials in Modifying the Fundamental Tone.

translated into audible vibrations are quite like those set up in an ordinary telephone circuit, except that they are enormously more powerful.

Briefly summed up, Dr. Cahill's wonderful invention consists in generating electrical oscillations corresponding in period with the acoustic vibrations of the various elemental tones desired, in synthesizing from these electrical vibrations the different notes and chords required, and in rendering the synthesized electrical vibrations audible by a translating device.

In the New York plant the electrical vibrations are produced by 144 alternating dynamos of the inductor type, having frequencies that vary from 40 to 4,000 cycles. These alternators are arranged in eight sections or panels, each inductor being mounted on an 11-inch steel shaft. One inductor dynamo is used for each note of the musical scale, each generator producing as many electrical vibrations per second as there are aerial vibrations in that note of the musical scale for which it stands. The fixed or stator part of each dynamo carries both the field and armature windings; the rotors are carried on shafts geared together, the number of teeth (pole pieces) on the gear wheels corresponding with the number of frequencies to be obtained. Because the rotors are geared together, the frequencies are fixed and tuning is unnecessary. The alternators are controlled each by a key in a keyboard upon which the musician plays. Each key serves to make and break the main circuit from seven alternators, not directly, but through the medium of plunger relay magnets wound with layers of enameled wire. Only feeble and harmless currents are needed to control the relay magnets, by which the task of making and breaking the currents from the main circuits is really performed. No appreciable time elapses between the depression of a key and the closing of a main alternating circuit, so that the keyboard is as responsive and sensitive as that of a piano. The elemental notes generated by the 144 dynamos cannot alone be used to produce the most pleasing musical effects. Why this should be so becomes apparent from a consideration of some simple principles in acoustics. If a wire be stretched between two points *A* and *B* (see the accompanying diagram) and plucked or struck, it will vibrate above and below the line *A*, *B* and give what is known as a fundamental tone. This fundamental tone is without distinctive musical character or timbre, and would sound the same in all instruments, so that one could not distinguish whether it came from a violin or a piano. In addition to its fundamental vibration between its points of attachment, the string undergoes a series of sub-vibrations above and below its own normal curve, which it will pass at certain points, nodes, dividing it into equal parts. Thus in the accompanying sketch, *A*, *C*, *B* and *A*, *D*, *B* represent the fundamental vibrations, and *A*, *E*, *C*, *F*, *B*, the first sub-vibration intersecting the fundamental vibration at the node *C*. Again, the string may vibrate in three parts, four parts, five parts, etc. The effect of the sub-vibrations is added to the effect of the fundamental vibration, and their total effect is heard in the distinctive quality or "tone color," as it is called, of the particular instrument played. The sub-vibrations are known as the upper partials or overtones, and generally speaking, they are harmonious with one another and with the fundamental tone. That very elusive and uncertain quality called timbre is dependent entirely upon these overtones. By properly controlling the blending of the overtones and the elemental tones, it ought to be possible to imitate the characteristic timbre of any musical instrument. This Dr. Cahill has in a large measure succeeded in accomplishing.

"Tone mixing," as this building up of harmonious notes and chords is called, is effected in the telharmonium by superposing the simple or sinusoidal waves of the alternators. By means of bus-bars the oscillations of the ground tones are all brought together in one circuit, those of the first partials in another circuit, those of the second partials in a third circuit, etc. The actual blending is done by passing the various oscillations through a series of transformers. In order to understand how a chord is blended, we must begin at the keyboard. As soon as the performer depresses his keys, the bus-bars electrically superpose the ground tone currents through the primaries of closed-iron magnetic circuit transformers, the secondaries of which are joined in circuit with impedance rheostats governing the strength of the currents, which rheostats are controlled from the keyboard by means of stops. Similarly the bus-bars superpose the first, second, third, and other desired partials in separate circuits. The composite ground-tone and overtone oscillations thus produced in the secondaries of the transformers are next passed through the primaries of an open-iron magnetic circuit transformer, in the secondary circuit of which a current is produced composed of all the ground tone and overtone frequencies of the particular chord under consideration. This secondary current is in turn passed through the primary of an air-core transformer, and the resultant secondary current is converted by telephone receivers or speaking arcs into the musical chord desired.

In order to listen to this musical chord, the telephone receiver is not held to the ear. It would be bad for the ear if it were, when a loud note is sounded. The current of the receiver is literally thousands, and at times millions of times stronger, measured in watts, than those to which an ordinary telephone receiver responds. Whereas less than six ten-millionths of an ampere are sufficient to produce a response from an ordinary telephone receiver, a current of an ampere is sometimes used in the Cahill system for an instant when loud tones are produced.

The composition or quality of a note or chord is controlled by eight rheostats called stops. By skillful manipulation of the stop rheostats, it is possible to obtain very accurate imitations of the wood-winds and several other orchestral instruments. Imitation, however, is hardly the right word; for the notes are built up of exactly the same components as the tones which come from the real instruments. Furthermore, beautiful effects are obtained that cannot be produced on any existing instrument. These stop rheostats control merely the timbre or quality of the music produced. Fluctuations in volume are produced by "expression rheostats." Both stop and expression rheostats are constituted by impedance coils, differing however in mechanical construction. The stop rheostats are manipulated very much like the stops of an organ, and the expression rheostats like the swell. Unlike an organ swell, however, the expression rheostats are used not only for producing captivating crescendos and diminuendos of individual notes and chords, but also in reproducing the peculiar singing tremolo of the violin and 'cello.

The rather complex system of transformers described serves not merely to blend partials with ground tones, but also to purify the vibrations corresponding with the different sets of partials by purging them of their harsher components. The air core transformers, fur-

thermore, permit the selection of voltages according to the resistance which the final current will encounter.

Inasmuch as each keyboard controls ground-tone and overtone mixing devices, it is possible to produce notes of the same timbre or of different timbres. Excellent orchestral effects can, therefore, be obtained by causing the one keyboard to sound wind instruments, such as oboes, flutes, clarinets, or horns, and the other to sound the tones of the violin or other stringed instruments.

From this necessarily cursory consideration of the telharmonium, it is evident that the music is initiated as electrical vibrations, distributed in the form of electricity, and finally converted into aerial vibrations at a thousand different places separated hundreds of miles, it may be. No musical instruments in the sense in which we understand the word are used. Not a string, reed, or pipe is anywhere to be found. The vibrations produced by the performers' playing are wholly electrical, and not until they reach the telephone receiver can they be heard. The telephone receiver acts for us as a kind of electrical ear to hear oscillations to which our own ears are insensitive.

When Mark Twain heard the telharmonium, he fancifully suggested that the military parade of the future would be a more beautifully rhythmic procession than our present pageants. The usual military bands heading the various regiments and playing marches, not in unison, although the same in time, will give place to musical arcs disposed along the line of march, all crashing out their strains in perfect time. The soldiers who will march in that future parade will all hear the blare of invisible electrical trumpets and horns at the same moment; they will all raise their left feet at exactly the same instant, just as if they were but one company.

So far as the capabilities of the telharmonium are concerned, it may be stated that the New York installation is able to supply ten thousand subscribers, or more, with music of moderate volume at widely remote places. The very remarkable and rapid development of the invention has been thus eloquently set forth by Prof. A. S. McAllister in an article published in the Electrical World:

"From Hero, who first proposed to utilize the motive power of steam, to Watt's first successful engine, was almost two thousand years. And between the proposal of Hero and the accomplishment of Watt many inventors in different countries made ineffective attempts to attain the goal desired. From Huyghens's proposal of an explosive motor to Otto's successful machine two centuries elapsed, with scores of patents in the different countries of Europe. So from Sir Humphry Davy's experimental arc to the Brush and Edison arc lighting machines, three-quarters of a century elapsed, during which scores of inventors in different countries endeavored to solve the problem in vain. Similar remarks apply to the progress of most great inventions, electrical and mechanical. But the process of producing music from dynamos has been carried from the first conception to the successful working machine by one man—Thaddeus Cahill—in a few years. And when one hears the plant at Thirty-ninth Street and Broadway, with its musical tones already equaling, if not surpassing, the instruments of the orchestra, one wonders what cannot be expected in a few years to come when the inventor will have had time to do his best, and when his work in all its details will be known to the world and open to improvement by others, and when musicians will have learned to use the new powers which electricity is placing at their command. Clearly the world has, through the wonderful powers of the electrical forces and the skillful use made of them by Dr. Cahill, a new music, a music which can be produced in many thousand places simultaneously, and which in its very infancy seems destined to surpass in sympathy and responsiveness—in artistic worth—the existing music of pipe and string, the evolution of many centuries."

Official Meteorological Summary, New York, N. Y., February, 1907.

Atmospheric pressure: Highest, 30.77; lowest, 29.62; mean, 30.10. Temperature: Highest, 44; date, 14th; lowest, 1; date, 12th; mean of warmest day, 38; date, 2d; coolest day, 8; date, 12th; mean of maximum for the month, 31.7; mean of minimum, 17.1; absolute mean, 24.4; normal, 30.6; deficiency compared with mean of 37 years, —6.2. Warmest mean temperature of February, 40, in 1890. Coldest mean, 23, in 1875 and 1885. Absolute maximum and minimum of this month for 37 years, 69 and —6. Average daily deficiency since January 1, —2.1. Precipitation, 2.52; greatest in 24 hours, 1.07; date, 4th and 5th; average of this month for 37 years, 3.74. Deficiency, —1.22; deficiency since January 1, —1.72. Greatest precipitation, 7.81, in 1893; least, 0.82, in 1895. Snowfall, 20.3. Wind: Prevailing direction, N. W.; total movement, 9.357 miles; average hourly velocity, 13.9 miles; maximum velocity, 48 miles per hour. Weather: Clear days, 9; partly cloudy, 11; cloudy, 8. Fog, 2d. The temperature of December was 1.3 below, January 1.7 above, and February 6.2 below normal; an average of 1.93 degrees below normal for the winter. The total precipitation for the winter had a deficiency of 1.59 inches.

Henri Moissan.

With the death of Prof. Henri Moissan on February 24, the world lost one of the greatest of modern chemists, certainly one of the best known. Among the latest of the many honors which Prof. Moissan bore was the Nobel prize for contributions to science and chemistry, awarded last December for his famous experiments in the isolation of fluorine and his researches into its nature, and for his application of the electric furnace to scientific uses. Like the achievements of the Curies, much of Moissan's work was spectacular in the extreme, though never unworthily so. Among his best known experiments, and one which made his name familiar to practically all the civilized world, was the formation of artificial diamonds in the electric furnace in 1893. The great chemist was remarkable for the unselfish nature of his work. Had he patented his discoveries, he would doubtless have been enormously wealthy; but he gave all he learned to the sum of human knowledge freely and ungrudgingly. While his discoveries were almost uniformly without financial benefit to himself, he vastly assisted commerce and trade, and added to the wealth of the nations by teaching new applications of modern chemistry to the industries.

Henri Moissan was born at Paris on September 28, 1852. He obtained his education principally at the Museum of Natural History in Paris, and subsequently at the School of Pharmacy. For four years, until 1883, he taught at the Higher School of Pharmacy, and later, in 1886, he became professor of toxicology at this institution. In the following year he isolated and liquefied fluorine, and for this achievement, together with his investigations into the nature of the element, he won the Lacaze prize from the Academy of Sciences. In 1889 he took the chair of mineral chemistry in the School of Pharmacy, and there conducted his important and far-reaching experiments with the electric furnace. In 1892 he carried out a series of investigations which rendered the manufacture of acetylene practicable and commercially profitable. His was the discovery that calcium carbide results from the fusion of carbon and lime in the electric furnace, and that from the former acetylene gas can be liberated without difficulty. In the following year Prof. Moissan performed his sensational experiments in the manufacture of artificial diamonds. He melted iron in the electric furnace and saturated it with carbon, the furnace being at a temperature of over 4,000 deg. C., that is, more than 7,200 deg. F. At this high temperature the furnace was plunged into cold water, and the resulting ingot was subsequently attacked with hot aqua regia; this agent dissolved the iron and laid bare the diamonds. It will be remembered, however, that these diamonds were usually too minute in size for practical use, but they were genuine, being pure crystals of carbon.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1627, is the second installment on the manufacture of gas, begun in the last number. The present installment deals with the manufacture of water-gas. Mr. C. W. Parmelee's paper on the technology and uses of peat is continued. The treatise on corn-harvesting machinery is continued, by Mr. C. J. C. Zintheo in a second installment. Much curious information is contained in an interesting article entitled "Swindling Alchemists of Bygone Days." Minor articles of interest are those entitled "What Demands Are We to Make on a Serviceable Preserve Glass?" "Transplantation in Surgery," "Old and New Theories of Lightning Conductors," "The Channel Tunnel." The paper on the advantages and applications of the electric drive by Prof. F. B. Crocker and M. R. Arendt is concluded. Most important is a discussion of apparatus and methods of distilling alcohol.

Portable Rotary Converter Substations.

The Illinois traction system, which has under construction several connecting lines of 40 or more miles in length, has found that portable rotary converter substations are quite useful at the time of first opening new lines. This company has five such substations, each consisting of a substantially-built box car carrying one 300-kilowatt rotary converter, together with transformers and switching apparatus. According to the Electric Railway Review, when a new line is to be opened, one of these sub-stations is set off on a temporary side track and a short pole, with standard high-tension cross-arms and insulators, is erected close to the end of the car. In this way the three-phase transmission wires may be brought to the high-tension disconnecting switches in the car.

Correspondence.

The Vagaries of Railway Time Tables.

To the Editor of the SCIENTIFIC AMERICAN:

If the subject is of sufficient importance, kindly allow me space to draw the attention of your readers to what appears to me a misuse of the 24-hour system of time, as given in many railroad time bills.

It is not unusual to find something like the following:

"This time bill will take effect at 24:01 on Saturday, February 16." When does that minute arrive? This being written at 15 o'clock on Friday, the 15th, nine hours from now will be 24 o'clock on Friday, the 15th, and the day and date is ended.

Now the notice of change in time bill given above is probably intended to take effect at one minute after midnight to-night. Certainly the one minute belongs to date 16th, but not the hour 24; because 24 o'clock on Saturday, the 16th, does not arrive until to-morrow night, and we have the hour belonging to one date and minute belonging to another used together.

It seems to me that when 24 o'clock arrives, the date and day terminate. Any time desired to be noted up to 1 o'clock following should be expressed as 0:01, 0:05, etc., and the notice first mentioned would read: "This time bill will take effect at 0:01 on Saturday, February 16."

I have spoken to different railroad managers and superintendents on the subject, but so far have failed to find any to admit the error which I have endeavored to explain. H. W. D. ARMSTRONG, M.C.S.C.E.

Saskatoon, Canada, February 15, 1907.

Tree Moss and Branches as Compasses.

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago an article appeared in your paper—I do not now recall the writer's name—in which he denied the saying, or rather belief held by many, that the limb growth of trees and the growth of mosses at the base of tree trunks indicate, in a general way, the cardinal points of the compass; and cited in support of his statement, that extensive observations made by him in the forest districts of Kentucky, Tennessee, and I think he included Georgia, proved to his satisfaction that such was not the case.

I have been looking for some reply to this article, but as none has appeared, I venture a word or two.

That the growth of limbs and moss does indicate a general north and south line, is a fact not disputed by those who follow the trackless wilderness as hunters, trappers, explorers, or "cruisers," and is used by all true woodsmen as a successful guide in cases of emergency. This condition of growth does not apply to all sections of the country, hence we are not surprised that the writer of the article referred to failed to find this condition in the forests of Tennessee, Kentucky, or Georgia; but it does apply to the immense timbered district of the North, and here is where the saying originated. This condition of growth will not be found in cut-over or second-growth timber lands, but prevailed in the original pine, fir, and hemlock forests of Maine, Vermont, New York, Pennsylvania, Canada, and elsewhere in the forest districts east of the Mississippi and north of say latitude 42; and there still remain large tracts of timbered country, untouched by the lumberman's ax, where those who can read the signs of the woods have a sure guide to general direction in case of need. In northern Minnesota and Michigan this and other methods peculiar to woodcraft have been used over districts of high magnetic disturbance, where the compass is as likely to point west, east, or south as it is to point north.

It may be interesting to note some of the methods used by those accustomed to the woods to ascertain general direction in cases of emergency. First we have the growth of limbs and moss. This does not apply to every tree, but does in a general way, and to these generalities the woodsman's eye is trained, and he sees in the same general way, that the longest, largest, and greatest number of limbs grow on the southerly side of the trees; that the moss is more profuse on the northerly side and grows to a point, while on the southerly side, if it grows up on the trunk, it is not as high and is rounded at the point of highest growth. He will also find that the bark is thicker on the northerly side, and on pine and hemlock is rougher and more deeply corrugated. The woodsman always carries a watch, and when his compass fails and the signs of the woods are not plain, he points the hour hand of his watch toward the sun, and takes a line half-way between the sun and twelve on his watch as the south. If the sun is obscured, and he is unable to determine its position, he is still not without resource, for he places the point of his pocket-knife blade on his thumb and holds it in a vertical position, and if he does not perceive a shadow a slight rotatory movement of the knife will produce it, then with his watch he finds the north and south line as before, and goes on his way rejoicing. HENRY S. ELY.

Duluth, Minn., January 18, 1907.

THE OPIUM INDUSTRY.

It is doubtful whether there is a more valuable remedy than opium in the materia medica. Contrary to the usual belief of the layman, opium and its chief constituent derivatives, codeine, morphine, apomorphine, and heroin, are not used for anæsthetic purposes alone; opium possesses medicinal properties which are of inestimable value in many diseases. It is almost trite to cite opium as an example of how abuse can convert a valuable and beneficial agent into a destructive power of the most degrading nature. This is undoubtedly truer of opium in the case of the Western races than in that of the Oriental ones; and it is claimed that the smoking of the drug, as practised moderately by the Chinese in comfortable circumstances, has not materially affected them, especially in respect to longevity; but the immoderate use of opium is most destructive even to the Chinese or Malays of the poorer classes, who are not constitutionally so well able to resist the terrible inroads of the drug upon the system and the mind.

In the very oldest records of the Arabs we find mention of the poppy, and proof that the use of the juice of the plant is one of the most ancient of practices. At first opium was undoubtedly used as a medicine alone. Theophrastus was familiar with it, and Dioscorides, as early as 77 A. D., wrote a learned paper on its properties and uses. Up to the twelfth century, Asia Minor was the source of supply, and from then on it was gradually distributed over the globe. The Chinese first obtained the drug in the thirteenth century, using it merely as a medicine; but gradually its insidious effects were realized, and it became so important a drug in a commercial sense, that in 1757 the great monopoly was secured in India by the East India Company. The business rapidly increased from 1,000 chests in 1776 to nearly 5,000 in 1790. At this time the Emperor Kea King fully realized the effect the drug was having upon his people, and in 1786 its importation was forbidden. Chinese caught smoking were flogged and otherwise severely punished; but this did not have the desired effect, and thereafter those who were detected using it were transported or beheaded. Even this did not affect the sale, and in 1825 the importation of opium into China had increased to nearly 17,000 chests. In 1839 the Chinese government made a desperate effort to drive off the English opium sellers by ordering away the British opium ships. The order not being complied with, nearly 30,000 chests of opium were destroyed, entailing a loss of $10,000,000. This act led to the war, and the final Treaty of Nankin in 1842.

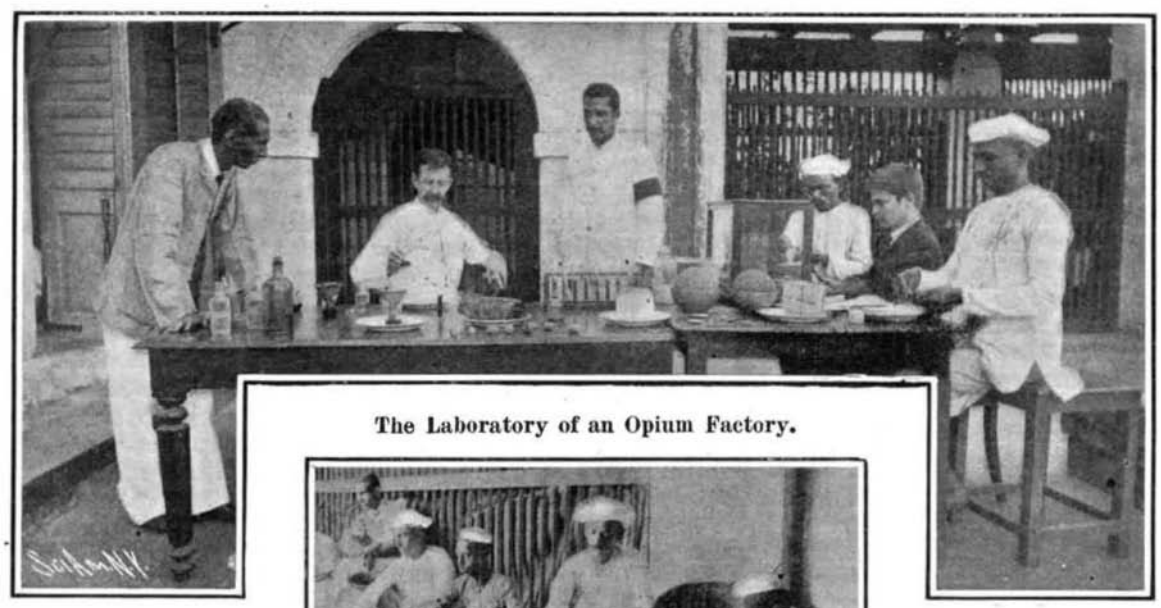
Some idea of the importance of the trade and the amount used can be seen from the fact that in Macedonia the crop is estimated at 140,000 pounds yearly; in Bengal, where it is a government monopoly, the output is equal to nearly 100,000 chests, valued at some $60,000,000; Persia produces about 10,000 chests, and Egypt about $10,000 worth annually, while it is said that Mozambique has 60,000 acres under cultivation for this purpose. Opium has been raised in Virginia, Tennessee, and California, as well as parts of Central Europe; but owing to the lack of cheap labor and the uncertainty of the crop because of frosts, the opium industry in these regions has never assumed profitable proportions.

Opium is fundamentally the dried juice of the unripe capsules of the *Papaver somniferum*, often known as the common poppy and less generally as the white poppy, though the latter appellation is really appropriate to one of its varieties alone. All varieties of the poppy are capable of producing opium, though the quantity and quality of that from certain kinds is very much inferior to that from others, particularly the variety mentioned above. The plant was discovered probably by the Arabs, and carried from Arabia over large portions of the globe. It is now found throughout the south and middle of Europe, in Great Britain, and the United States, principally as a garden plant. In India its cultivation for opium is carried on in various parts of the country, as much as a million acres being under cultivation for this purpose. But the chief opium district is a large tract on the Ganges in Bengal, and the accompanying illustrations are of various phases of the industry as carried on in an opium factory in Patna. For the profitable cultivation a rich soil is requisite, and in India the fields are usually located in the neighborhood of villages, where manure can be easily obtained. The soil should be fine and loose when the seed is sown, and the subsequent cultivation consists chiefly in thinning and weeding. In certain localities irrigation is practised. Mild, moist weather with night dews is considered most favorable by the native growers during the time of the collection of the opium. Very dry weather has been found to diminish the juice, and heavy rain is injurious. In India the seed is sown in the beginning of November; the plant flowers late in January or early in February, and within three or four weeks after this the poppy heads are approximately the size of hen's eggs and are ready for the manufacturer. Prior to this, however, the fallen petals of the flowers are carefully gathered and sorted according to condition in three grades. They are then heated over a slow fire, and formed into thin cakes to be used for covering the drug in later stages of its preparation.

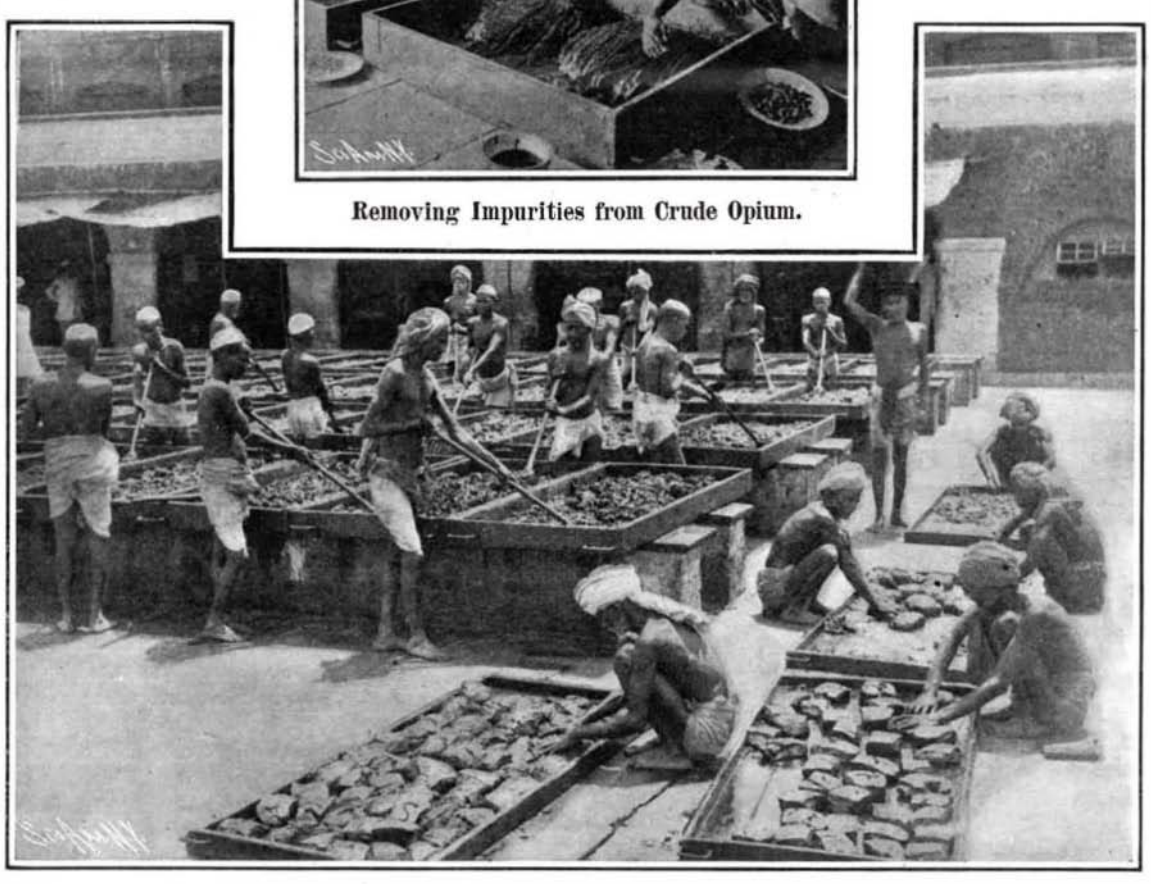
The poppy grower now begins to collect his harvest, and the first step in the operation is the making of a number of perpendicular wounds in each poppy head, care being taken not to penetrate the cavity, by means of a small four or five pronged iron instrument called a *nushtur*. The incising is always performed in the afternoon, and early on the following morning the milky juice which has exuded from the cuts is gathered by scraping it off with a small trowel-like scoop, called a *sittooha*. The gatherer places the juice in an earthen vessel, called a *kurrace*, and lets it stand, stirring it occasionally for a period of several weeks, until the collector for the opium factory visits his village, and the opium is weighed, graded, and purchased.

The compound of the opium factory contains many hundred earthen jars of crude opium, which has been freed by hand of larger impurities, each jar containing one maund or nearly 82 pounds, and all separated into lots of a hundred jars. After a rigorous examination by the superintendent, the jars are carried by native workers to a large room containing a number of stone cisterns or vats with walls raised about five feet above the floor, and with narrow passages between every three or four vats. The vats each hold 2,100 maunds, or over 150,000 pounds of opium. Into these vats the jars are emptied. The vats are filled to the brim with the soft, mahogany-colored substance, which here and there hardens to a glistening crust. The jars are scraped out by hand, and when broken the shards are carefully washed and cleaned, so that no speck of the valuable substance shall be wasted. The workers enter the vats, and so that they shall not sink into the opium as into so much quicksand, they stand upon planks which serve as rafts, and then scoop up brass basins full of the substance and hand these to women carriers, who take them to the official weigher. After being weighed, the opium is thoroughly mixed in shallow vats by coolies, who use rake-like implements for the purpose. After this it is trampled by the feet of others, who walk around and around in the vats. Curiously enough, no ill effects have ever been noticed in these coolies, who sometimes walk for periods of four or five hours in the opium.

After being mixed thoroughly in this manner, the opium is allowed to stand for some time, and is then weighed into tin vessels and carried to the caking room, where it is packed for the Chinese trade. Here the weighers sit in iron cages, weighing out opium in just the right amounts to the packer's assistants, who carry the pats of opium on platters to the men who do the actual packing. Each packer sits at a bench with a brass cup on a tray before him. Near this is a pat of opium on the platter, a small cup of liquid opium or lewa, and a pile of the pancake-like poppy-leaf wrappers, as well as a tin box full of tickets with his number printed thereon. The assistant kneels before him, holding a wrapper which the packer takes, tears to a convenient size and deftly arranges in the cup, smearing it over with the liquid opium. Leaves are added bit by bit, until a bed of the requisite thickness has been formed. The opium is then placed in the cup, the edge of the leaf drawn up, and in a few moments it has all been arranged into a nearly perfect and evenly-covered sphere. The sphere is, of course, still soft and pulpy, and is called a cake. The cake is handed to the assistant, who takes it to the examiner. When the latter has passed it, it is covered or dusted with a sort of bran of dried poppy leaves, and is then fitted in an earthen cup and placed in the storeroom to mature for some six months. At the end of this period, the cakes are packed in wooden chests, and



The Laboratory of an Opium Factory.



Removing Impurities from Crude Opium.

Manufacturing Excise Opium.

sent to Calcutta for sale. The opium used in India itself is differently prepared, being first dried in the sun till it reaches a certain degree of hardness, and then pressed into large square blocks closely resembling cakes of brown transparent soap.

Santos Dumont's New Aeroplane.

Santos Dumont is now engaged in constructing a new aeroplane which will be built on the same general lines as the one with which he made his first flights at Paris and which we have already had occasion to speak of several times. The new aeroplane has the double wing form, which gave the first flyer the name of "bird of prey," and the spread of the wings from tip to tip is about the same as in the former one, this being 36.5 feet very nearly, instead of 39.8 feet as before. As before, the wings will be made up of canvas-covered cells resembling box-kite cells, covered with canvas, and the wings will be placed at an angle largely opened at the top. However, there is some difference this time in the material which is used for the wings. In order to make them more solid they are built, at least for the upper and lower bearing surface, of a thin mahogany board which the aeronaut considers will be an improvement. This time the wings are quite narrow, and measure only 60 centimeters in width. In the former aeroplane the width was 2.60 meters (9 feet). As regards the total carrying surface of the aeroplane, this is considerably smaller, and does not exceed 13 square meters (15.55 square yards). In spite of the use of heavier material for the construction it is found that on account of the diminution of the surface and also owing to the suppression of one of the rolling wheels placed under the aeroplane, the total weight of the flier is now lowered to about 30 kilogrammes (66 pounds). A new idea is that of driving the flyer in the opposite direction from the first one, and now the head will become the tail, and the propeller is to take the aeroplane forward instead of driving it from the rear as before. During the first trial it is intended to mount the 50 horse-power Levavasseur motor which formed part of the first flyer, and which we have already illustrated. After testing it with this power, Santos Dumont will then use the 100 horse-power motor of the same make which he had built recently. Like the former, it is constructed of aluminium very largely. A novelty in the flyer is the use of only one wheel to be mounted underneath the central framework. This is a small bicycle wheel with a rubber tire, and when upon the ground the pilot will sit so that he can touch the ground with his feet. The middle framework, of wood strips, is even shorter than before, with just enough room for the motor and the aeronaut's saddle. Santos Dumont considers that he will need a speed of 80 kilometers (50 miles) an hour so as to make the flyer sail up from the ground. This he may be able to reach even with the 50-horse-power motor, and with the 100 horse-power he expects to be in good condition for sailing. As there is not enough room around the present shed in the suburbs of Paris, he is constructing a new shed at St. Cyr, not far from Versailles, on a large tract of ground. The surrounding country is level and gives a good field for further experiments.

Scraping the Broken Jars.

War Balloons for the United States Army.

As the readers of the SCIENTIFIC AMERICAN are aware, certain of the European governments for years past have taken a very active interest in aeronautics for military purposes, and this science has been developed to a very great extent by the various armies of the Continental countries. Although our government has been slow to take the same interest in aerial navigation, the value of the balloon in war has finally been recognized, and the War Department has established an aeronautic corps as a regular branch of the army. The successful experiments made with war balloons, particularly in France and Germany, have prompted the government to conduct a series of tests at Fort Omaha, in Nebraska, where the aeronautic corps is to be stationed. The latter will be under the direction of Gen. James S. Allen, commander in chief of the Signal Corps.

It is the intention of the government to establish a complete aerial station at Fort Omaha for experimental purposes, and for the thorough training of the officers and men of the aeronautic division. A hydrogen-gas supply tank with the necessary accessories has already been constructed, and with the completion of the three large balloons ordered from the aeronaut Leo Stevens, the corps will be ready to begin its work.

The balloons are of the ordinary type, nearly spherical in form, and are not intended to be dirigible, as are the cigar-shaped balloons lately introduced by the French government, in accordance with the well-known forms favored by so many aeronautical investigators. The United States army balloons are simply large gas bags provided with the usual baskets, and are free to soar with the prevailing winds. Hitherto the only balloons experimented with by the War Department have been captive ones, useful merely to study the position of an enemy. While the present balloons are intended chiefly for signal work, they may also be made capable of carrying bombs to drop upon the opposing lines.

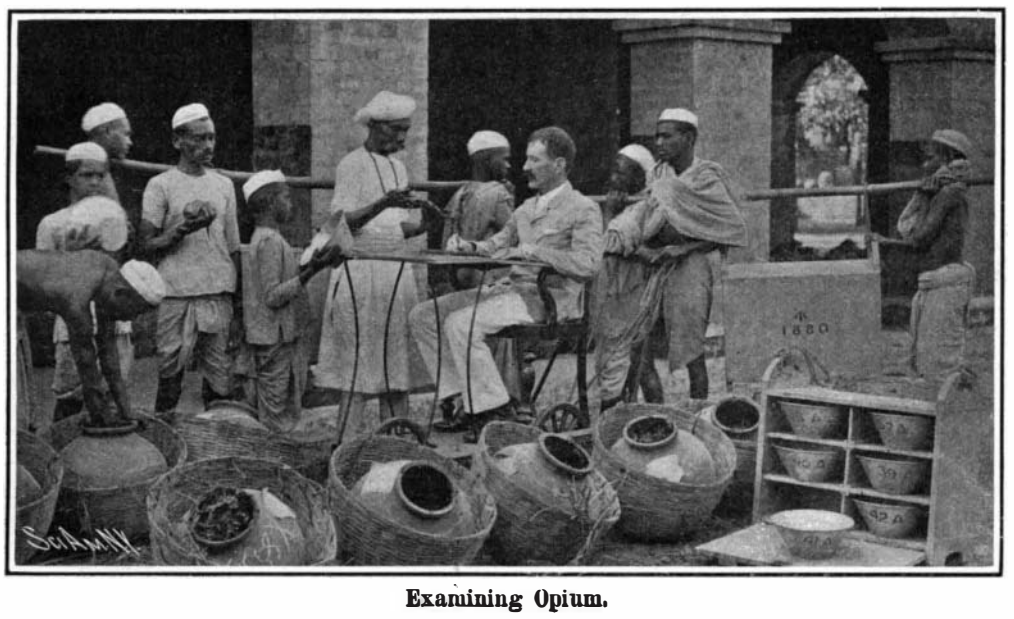
Manufacturing Lewa.

Weighing Opium.

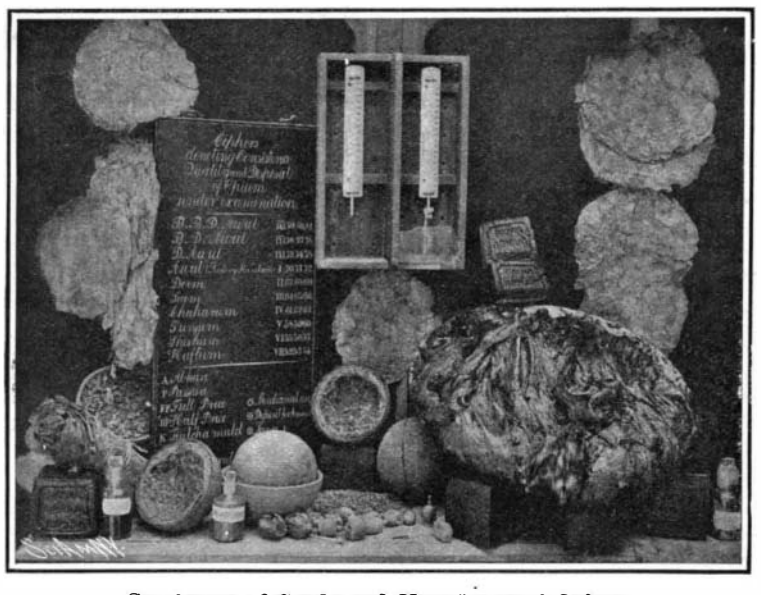
A New Arc Lamp.

A new arc lamp is brought out in Germany by the engineer Tito Carbone. It is provided with a magnetic device for blowing the arc, and this is said to give a great increase in the lighting power as well as to improve the quality of the light, and the latter resembles sunlight in color. The great lighting power of the lamp is caused by the special form which is given to the electromagnet which blows the arc. Owing to this form the arc is made to take a hemispherical shape and it is kept in this position, which assures a regular wear of the carbons. The length of the arc requires a high tension and for direct current 85 volts is needed, and 75 volts for alternating current. The Carbone lamp, with 16-inch carbons, will burn for 14 to 16 hours in spite of the small diameter of the carbons. For direct current it uses 7 to 9 millimeter carbons. About 10 amperes current is needed. Prof. Wedding, of Berlin, estimates the luminous intensity in the vertical direction and near the bottom to be 4,000 candle power, using a current of 10 amperes and 110 volts, this with a clear glass globe. Owing to the oblique position of the carbons, the arc and the crater can project almost all the light downward, which is an advantage. An automatic regulation of the arc is given by an electromagnetic device.

The imambra connected with the Mohammedan mosque at Lucknow, India, says Valve World, contains the largest room in the world without columns, being 162 feet long, 54 feet wide, and 53 feet high. It was built during the great famine in 1784 to supply work for a starving people. It is a solid mass of concrete of simple form and still simpler construction. In its erection a mold or framework of timber and brick several feet in thickness was first made, which was then filled with concrete. The concrete was allowed about a year to set and dry, when the mold was removed. Although the building has been standing 122 years, it is said to show no signs of decay or deterioration.



Examining Opium.



Specimens of Crude and Manufactured Opium.

THE OPIUM INDUSTRY.

THE UVIOL LAMP.

In addition to the visible radiation, all light contains also dark rays, not perceptible to the eye. These are known either as ultra-red or heat rays if their wave length is greater than that of visible light, or as ultra-violet, actinic, or chemical rays, when of shorter wave length than the visible spectrum. Within the last ten or twenty years, the development of physics and medicine has disclosed certain properties of this form of radiant energy, which are not only highly interesting from the point of view of pure science, but seem calculated to be of great service to mankind. In consequence, the demand has arisen for a practical and comparatively cheap form of apparatus for producing these ultra-violet rays, or as we may term them briefly, "uviol" rays.

The want has been supplied by a modification of the Hewitt mercury vapor lamp, the walls of which are made of a special glass.

The new lamp consists of a tube of suitable shape—usually straight—made of special glass transparent to uviol rays, 8 to 30 millimeters in diameter and 20 to 130 centimeters long. Platinum terminals are fused in through the glass at the two ends, and are tipped with carbon knobs, so that each pole may be used either as a positive or as a negative pole. The lamp contains 50 to 150 grammes of mercury, according to its size. This mercury not only furnishes the vapor necessary for the working of the lamp, but also serves for starting the luminous discharge and for cooling the negative pole. The dimensions are so calculated that the lamp can be connected up to leads of the usual tension of 220 or 110 volts without undue loss of current.

To light the lamp, it is not enough simply to connect it to the leads; the two poles must be for an instant joined by means of the mercury in the lamp, which for this purpose is tilted so as to allow the metal to flow from the one to the other. When once the discharge is started, it will continue after the mercury has fallen back to its normal position. The lamp being made with carbon poles, the ignition may be effected from the positive to the negative end, or *vice versa*, without injury to the lamp (through disintegration or fusion of the platinum terminals); the negative pole may even be laid bare for several seconds without harm while the lamp is being lighted. When, however, it is to run for a prolonged period, it is imperative that the negative pole be immersed in mercury.

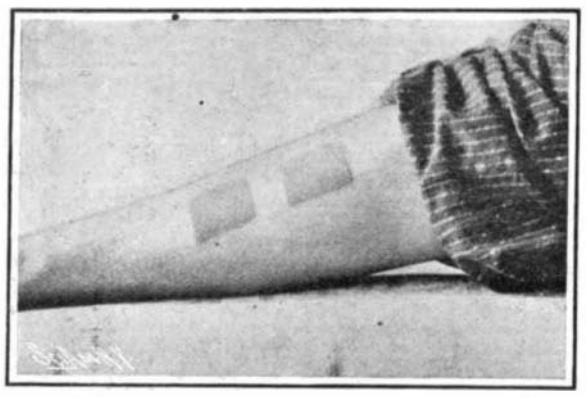
In order to obtain a maximum transformation of current into radiant energy with a difference of potential of 130 to 190 volts at the terminals (220 at the leads), the tube must be at least 130 centimeters long. Such a long tube is awkward to handle, especially in the operation of igniting the lamp. It may be shortened to one-half by giving it a U shape. This also broadens the field illuminated. The same form, on a smaller scale, is also very practical when internal cavities of the human body are to be exposed to uviol radiation. Two or three lamps of 50 to 60 centimeters length each may be connected in series, and arranged one above or behind the other as required.

The spectrum of the uviol lamp consists of a very large number of lines ranging in wave length down to 253 micromillimeters. From 405 downward these represent uviol rays, and this portion comprises about four-fifths of the whole compass of ultra-violet light which is transmitted for any considerable distance through air.

The light of the lamp displays all the properties characteristic of ultra-violet waves. Ozone can be detected by its odor. A negatively-charged electroscope is rapidly discharged by these rays. Great care must be taken to avoid continued exposure of the eyes to the light of the lamp, as it will cause inflammation.

It is difficult to form any idea as to the manner in which the light is produced in the tube. There seems to be some reason for supposing that the ultimate particles of mercury in the evacuated tube are hurled with great velocity by the electric current from the negative to the positive pole, thus acquiring a very high temperature, and emitting intense light. The rays of short wave length so produced render the mercury vapor conducting, thus establishing a path for the continuous electric discharge through the tube.

The uviol lamp has a remarkably deadly effect upon small insects. A common fly dies within one minute when brought to a distance of about 1½ centimeters of the lamp—a distance at which the heat cannot be sufficient to be harmful. Under a lamp which was suspended near an open window at night, in summer, thousands of small dead insects could be swept up in the morning. On smaller organisms also, on bacteria, the uviol lamp exerts a fatal action.



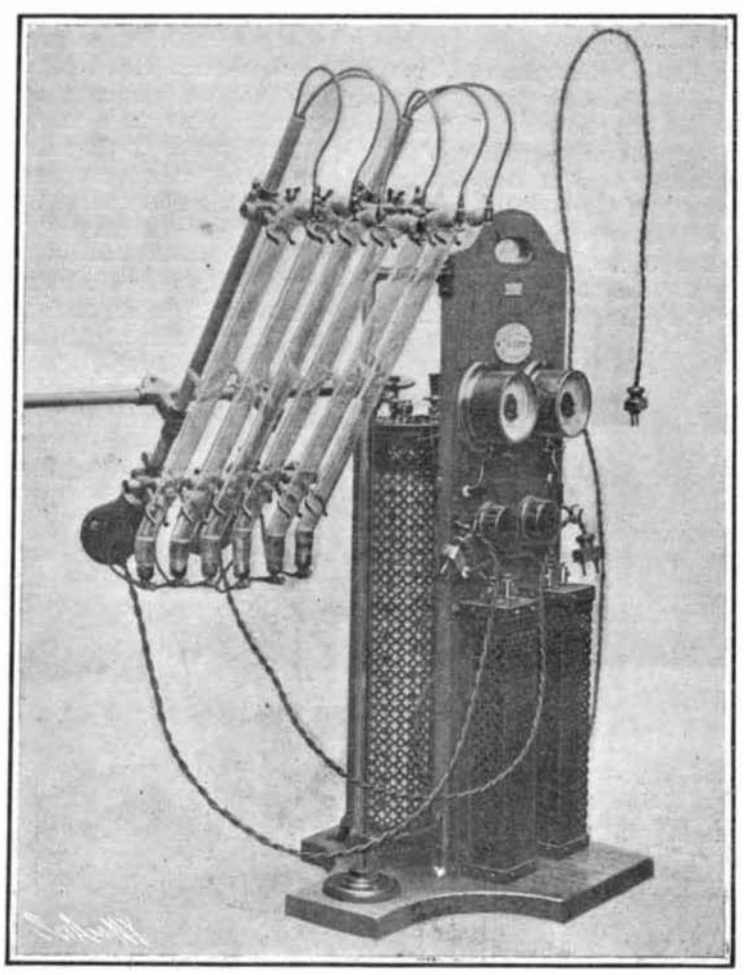
THE RESULT OF A FIFTEEN MINUTES' EXPOSURE TO THE RAYS OF THE UVIOL LAMP.

The most important and also the most interesting application of ultra-violet light is the use to which it has of recent years been put in medicine for the treatment of skin diseases. It was Finssen who, some twelve years ago, did the pioneer work, and created a sensation with his lupus cures. For his source of ultra-violet light he used the ordinary carbon arc lamp, fitted with water cooler and projecting piece. Although such a lamp sends out comparatively little radiation of short wave length, it was found possible to increase the proportion of the latter by increasing the dimensions and using large currents. From the nature of this arrangement it is plain that only a small patch can be treated at a time, and that hence frequent sittings are necessary for dealing with diseased areas of considerable dimensions. Besides, the large quantum of heat and light unavoidably emitted along with the ultra-violet rays is not only an irksome factor in this procedure, but also renders it rather costly.

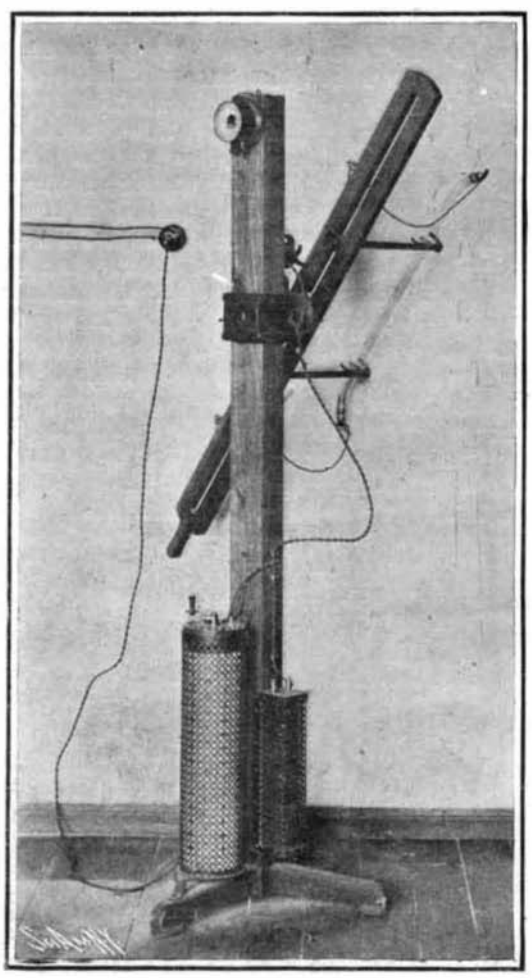
The case is very different with the uviol lamp. Owing to its expanded form, it furnishes a means for exposing large surfaces, ranging in area to 1,400 square centimeters, to intense radiation, and, owing to the small amount of heat emitted, it may be approached to within less than a centimeter.

If the normal, healthy skin is exposed for 5 to 15 minutes to the action of the uviol lamp at a distance of 1 to 3 centimeters, there is at first no visible change. It is only some hours after the exposure that a reddening appears, which continues to increase for about a day, at the end of which period it reaches a maximum. At this stage a slight burning sensation is felt, a few days later the patch of skin begins to itch and peels off, and the redness ultimately disappears in the course of two or three weeks.

When properly handled, the uviol lamp may be used for 1,000 hours without appreciably deteriorating.



UVIOL LAMP WITH RHEOSTATS AND MEASURING INSTRUMENTS.



UVIOL MERCURY LAMP CONSTRUCTED AT JENA.

A Concourse of Kites in France.

This year the Société Française de Navigation Aerienne is organizing its annual concourse of kites, which will be held on the same lines as last year's very successful contest. It will be managed by the aviation committee and the concourse will be held on the military maneuver grounds in the eastern suburbs of Paris, at Vincennes. There will be three general divisions for the trials of the kites and the observations will bear first upon the altitude; second, on the greatest weight which is lifted; third, deviation; fourth, transport of life-lines; fifty, aerial photography. Commencing on April first, the trials will be held on the following Sundays. Engagements are received up to March 22 at the office of the secretary, Civil Engineers' Building, 19 rue Blanche, Paris. The secretary will furnish a detailed set of rules for the contest.

Tunnel Ventilation.

In a paper read by M. C. Birault upon tunnel ventilation before the Société des Ingenieurs Civils, he speaks of the method used in the Paris subway, among others. The conditions of the air supply are known in a very exact manner from the analysis of the air and temperature tests, also water vapor measurements, made by M. Albert Levy, of the Montsouris Observatory, for some years past. Air is taken in each tunnel midway between the stations at 4 o'clock P. M. each day. The Vincennes-Maillot subway station, the first to be built, is entirely underground, except the open-air station at the Bastille. As was to be foreseen, it is in the western part of the tunnel that the air is the most vitiated, due to the length of the tunnel, 4.3 miles, and also because this part has the most traffic. The quantities of carbonic acid continue to increase as we proceed from the open-air station at the Bastille in either direction. Then a diminution is noticed toward the ends of the line. The atmosphere of the tunnels is always more humid than that of the outer air, and the water vapor figure varies about as the carbonic acid. As to the temperatures, they are not much influenced by the variations at the surface even when great. The action of the seasons has but little influence, and the mean temperature of the air in the tunnels is only about 3 deg. C. lower in winter than in summer. In a given day, the hourly variations of temperature follow a very regular law in all seasons. We observe a minimum at 4 o'clock A. M. and a maximum at 8 P. M. The thermometer falls in a noticeable manner from 12:30 A. M., when the traffic ceases and the station doors are opened in order to aerate the tunnel. In one section a series of observations were made. In summer the highest temperature is 21 deg. C. and the lowest is 22.5 deg. In winter we find 20 and 17.3 deg. respectively. Carbonic acid gas, observed during the night from 1 to 5 o'clock A. M., is found to be 48 liters per 100 cubic meters of air. From 4 to 10 o'clock P. M. it is 108 liters. The mean night temperatures are 17.5 and for the day 19.7. The present ventilation is therefore very good in lowering the amount of carbonic acid, but has no great effect on the temperature. In the later tunnel (line No. 2) which has air openings and a motor fan system, the amount of carbonic acid is lowered to 100 liters per 100 cubic meters. In line No. 3, which is of more recent construction and has a lighter traffic, the figure falls to 70 liters.

Patent Department

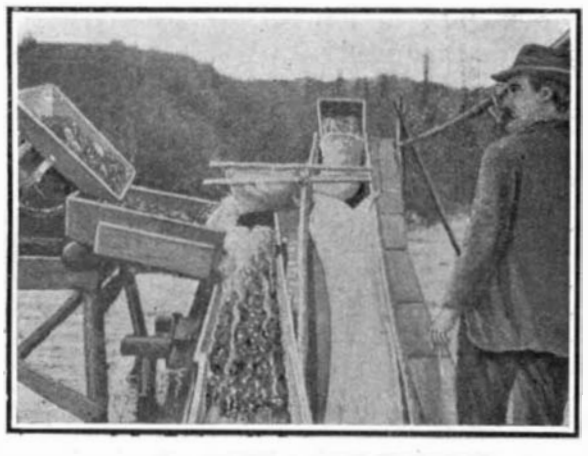
MODERN USE OF AN ANCIENT INVENTION.

People living in sparsely-settled or frontier regions, and who are denied many of the luxuries of modern civilization, would profit by studying the simple but ingenious expedients which went to make up the civilization of the ancients. One of the readers of the SCIENTIFIC AMERICAN, in the gold regions of Alaska, has thus profited by his acquaintance with ancient hydraulics. Mr. J. M. Weldon is a placer miner, and in his work requires some means of raising water for washing the gold-bearing gravel. At the Forty-Mile River, where Mr. Weldon is conducting his operations, it is entirely impractical to convey the water by ditch from some higher level, because the river bottom lands are underlaid with glacier ice. Several attempts were at first made to thus convey the water, but no sooner was the water turned into the ditch than it melted a hole in the bottom and ran out. Hole after hole was flumed across, but still the water found its way through the ice bottom. It was then that Mr. Weldon bethought himself of a primitive pump which he had seen pictured in one of his early school books. The pump consisted of a gutter or trough mounted to rock like a seesaw in a stream or other body of water, so that the ends would alternately be submerged, and on rising would deliver the water they scooped up to a trough leading from the fulcrum of the pump. This apparatus offered a promising solution of the difficulties at Forty-Mile River, for with it the necessary water for sluicing could be raised directly from the river wherever desired.

RAISING WATER WITH A SEESAW PUMP.

The pump was built on a point which jutted out into the water. As shown in the engravings, a framework is erected at the end of this point. Mounted to rock on the framework is a beam 22 feet long, provided with a large scoop at each end. The scoops consist of open boxes provided with valved bottoms, which permit them to fill as soon as they touch the water. The boxes are tilted inward, or toward the center of the beam. The inner end of each box opens into a 10-inch canvas hose, which conducts the water to the sluice box. To rock the beam the operator walks back and forth upon it, applying his weight first to one and then to the other side of the fulcrum, as shown in the illustration. To facilitate this operation the beam is floored with boards, and a hand rail is provided which is supported by a pair of tripods erected in the river. The scoops take up about 20 gallons of water at each lift, and raise it about 4½ feet higher than the head of the sluice box. A hopper is provided at the head of the sluice box, and leading to this is a gang plank for the wheelbarrows in which the gold-bearing gravel is conveyed.

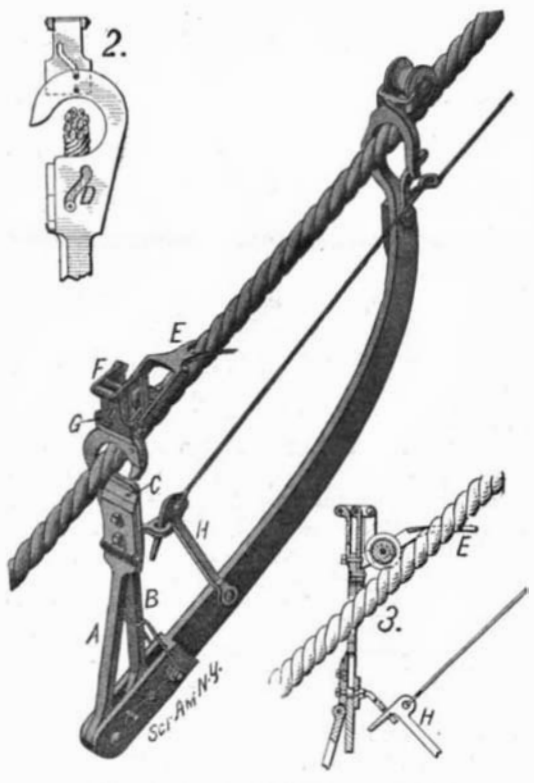
Mr. Weldon operates the apparatus alone, first loading the hopper with four wheelbarrow loads of gravel, and then rocking the beam until the entire charge is sluiced through, the tailings being washed out into the river. Several times he has had to dismantle the apparatus and draw it up on high ground, owing to high water, but the task of rebuilding it was not a very serious one. With this primitive pump, Mr. Weldon claims that one man can sluice through as much as two men can dig and shovel into the hopper.



SLUICING-THROUGH A LOAD OF GRAVEL.

IMPROVED CABLE-CUTTING DEVICE.

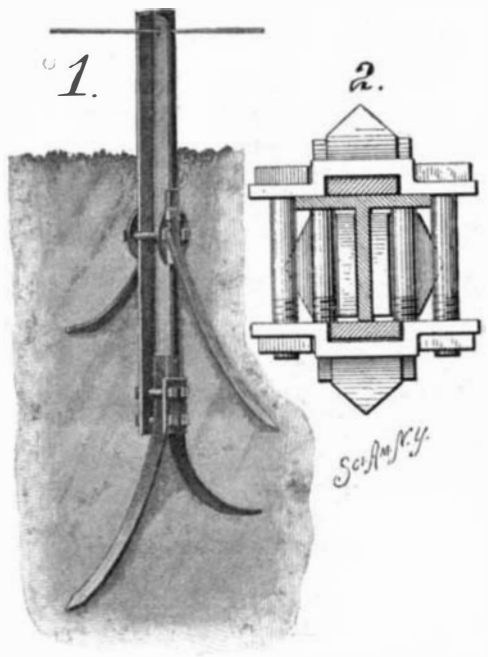
Pictured in the accompanying engraving is an improved device adapted for cutting ship's cables at any point along their length. It consists of a frame mounted on rollers, which are hooked over the cable. The frame is adapted to travel down the cable to any desired point, whereupon, by the pulling of a cord, a pair of knives are operated to sever the cable. As shown in Fig. 1, the forward end of the frame carries two levers, *A* and *B*, whose fulcrums are separated by a short space. Hinged to the upper end of lever *A* is a plate, which carries a knife blade *C*. This plate is connected to lever *B* by means of a bolt, which passes through a slot *D* therein. The upper end of lever *B* is formed with a hook, which passes over the cable. Connected with this hook is a fork or a dog *E*, which rests against the cable. Now, if the frame be drawn back up the cable by means of a cord, the dog *E* will engage the cable, arresting the upper end of lever *B*. The levers *A* and *B* will then be swung on their fulcrums, forcing the knife blade *C* to cut through the cable. To assist in this cutting action the slot *D* is curved, as shown in Fig. 2, so as to give a shearing motion to the knife blade. In addition to the blade *C* an upper blade *G* is provided, which is connected by links *F* with the dog *E*, in such manner that when the frame is drawn upward, the knife will move down to assist in severing the cable. This knife is also given a shearing motion, by means of a curved slot therein, which is engaged by a fixed bolt. To prevent the knives from operating under normal conditions, a spring bears against the lever *B*, holding it in inactive position. In addition to this a hook *H* engages an eye on this lever. The cord by which the knives are set in action is attached to this hook, so that when it is pulled taut the hook will be disengaged from the lever, permitting the parts to operate. The inventor of this device is Mr. Charles Petrie, Office of the Government Engineer, St. Johns, Newfoundland.



IMPROVED CABLE-CUTTING DEVICE.

ANCHORING DEVICE FOR POSTS.

The anchoring device which is herewith illustrated is particularly adapted for use on metal fence posts. Briefly stated, it comprises a series of prongs so mounted that when they are driven down they curve outward and are imbedded into the ground on all sides of the post, thus holding the post firmly in upright position, even when subjected to severe lateral strain. Each post is supplied with an upper and lower set of anchoring prongs, the two sets being at right angles to each other. The fence post is T-shaped in cross-section, consisting of a head with a central web or flange. A plate is secured to the lower end of the post against the outer edge of the flange by means of two upper and two lower bolts, which pass through the head of the post. Resting against opposite faces of the flange, between the head and this plate, are two anchoring prongs, which consist of narrow plates of metal pointed at the lower ends. The prongs pass under the upper bolts, but their points curve out over the lower bolts, so that when they are driven downward they will spread outward, as shown in the engraving. At a convenient point above the lower prongs a pair of straps are bolted to the post. These are bent to form sockets, in which the upper pair of prongs are seated, as best shown in the section view. The straps are framed with offsets, which cause the points of the prongs to curve outward. As stated above, these prongs are set to spread at right angles to the lower prongs. In practice the post is driven or sunk into the ground, and then, with a suitable instrument, the prongs are driven down, when they will assume the positions shown in the engraving. The inventor of this improved anchoring device is Mr. Percy T. Bailey, Melville Station, Newport, R. I.

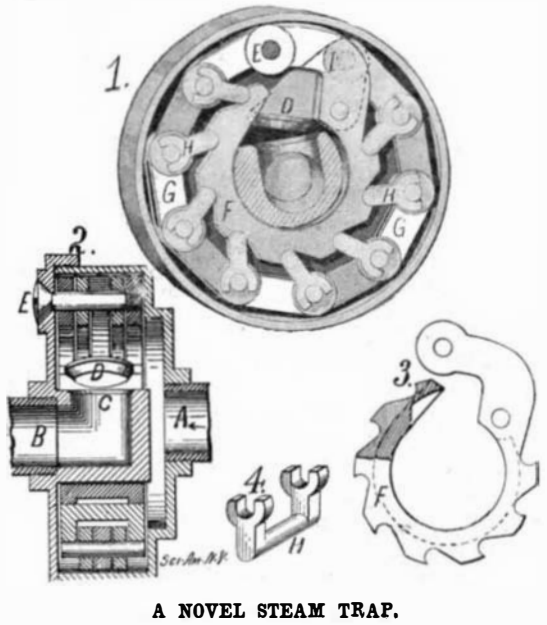


ANCHORING DEVICE FOR POSTS.

A NOVEL STEAM TRAP.

The purpose of a steam trap, as is well known, is to permit the flow of water while arresting the escape of steam. Usually this is accomplished automatically by means of thermostatic devices, which operate to close a valve when the temperature rises with the presence of steam in the trap. The trap which is herewith illustrated belongs to this same general class, but the method of applying the thermostatic principle is decidedly unique.

As shown in the cross section, Fig. 2, the trap is fitted with inlet and outlet pipes, *A* and *B* respectively. Communicating with the outlet *B* is a valve seat *C*, in which the valve *D* is adapted to be seated. The valve *D* is carried by a lever that is fulcrumed to an expansion collar *F*. This collar, as best shown in Fig. 3, is split and is formed at the sides with notched flanges. One end of the collar is formed with an arm, which is fastened to the casing of the trap by means of an eccentric pin *E*. This pin also serves to hold one end of an expansion chain *G*, the opposite end of which is attached at *I* to the lever that carries the valve *D*. Seated loosely in the notches of the expansion collar *F* are a series of U-shaped rockers *H* (Fig. 4) whose forked ends engage the pins that join the links of the expansion chain. Fig. 1 shows the normal position of the parts, when the water is free to flow from inlet *A* through valve seat *C* to outlet valve *B*. After the water has escaped and steam begins to flow into the trap, the collar *F* and chain *G* will expand with the increase of temperature; and as they are both secured to the casing at *E*, the expansion will take place in opposite directions. The rockers will then swing inward, or toward the expansion collar, permitting such elongation of the chain as will seat the valve *D*. The relative positions of the various parts

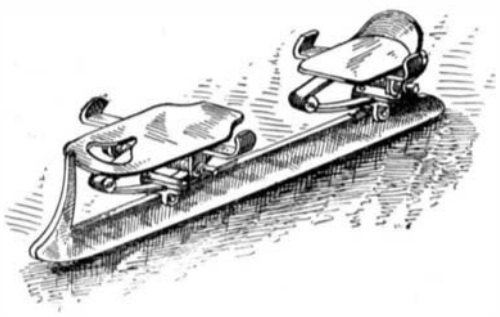


A NOVEL STEAM TRAP.

may be adjusted by turning the eccentric pin 20. The inventor of this novel steam trap is Mr. John Langridge, 108 High Street, Ramsgate, England.

ODDITIES IN INVENTION.

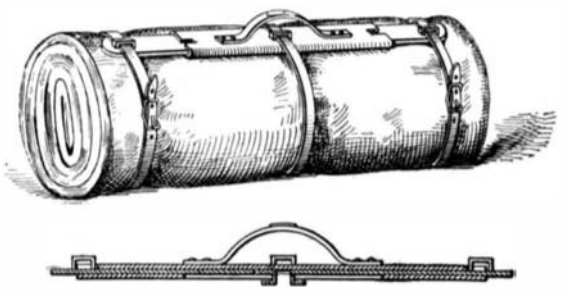
Spring Skate.—A novel improvement in skates has recently been invented by a resident of Troy, N. Y. In place of rigidly securing the skate blade to the foot-plate, the plates which support the heel and ball of the foot are separately mounted on springs. The forward spring is rigidly secured to the skate, but the rear spring is adjustable to several positions, in order to accommodate it to different sizes of shoes. Ordinarily



SPRING SKATE.

springs are used to cushion shocks and jars, but no such reason is argued for equipping skates with springs. Instead the springs serve to provide a certain flexibility that is impossible with the present rigid form. With such skates the skater can glide through various figures with much greater ease and freedom, and he will find the recreation less tiring, because he can move his foot at will, shifting his weight from the heel to the ball of the foot.

Extensible Shawl Strap Bar.—One of the objections to a shawl strap as heretofore made is the fact that it is not adaptable to all sizes of bundles; the shawl strap bar being of fixed length serves as a limit to the length of the bundle upon which it may be used. To overcome this objection an Australian inventor has recently devised an extensible shawl strap bar which may be adjusted to any desired length. The



AN EXTENSIBLE SHAWL STRAP BAR.

method of accomplishing this result is clearly illustrated in the accompanying engraving, and will be understood at a glance.

Some Novel Types of Matches.—Pictured in the accompanying engraving are several novel types of matches. A flexible type of these is represented in Fig. 1, which shows a strip wound up into a roll. The strip is lapped, and provided with igniting means at regular intervals. When it is desired to utilize a match the roll is grasped, the strip is pressed just above a lap, and the projecting end of the strip is pulled. A separate edge view is given of this lap or fold, which consists of a lapped-over portion adhering to the main part. The fold under its right end is supplied with a rubbing surface. The left end of the adjacent surface is provided with an igniting compound, which when brought into contact with the rubbing surface is ignited by friction. This does not claim to be a safety match. Fig. 2 shows an excellent device in the form of a match box. On inverting it one of the combustible pellets in the box readily passes into the neck and enters the cap. The latter is cut away so as to expose the top side of the pellet to contact with a rough surface for purposes of ignition. The pellet enters on moving a slide valve inward against spring tension. This valve on its return to normal position supports the pellet within the cap. The pellet can be ignited by drawing it across any roughened coating, and the highly-inflammable center of the combustible compound will burn for some time. The draft perforators in the cap assist the combustion.

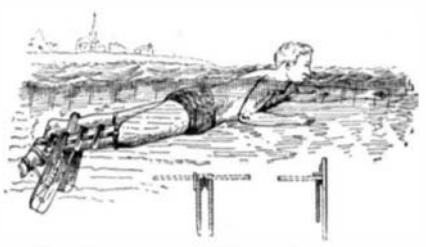
In Fig. 3 we have a match strip folded in zigzag or accordion pleat before being finally compacted, as shown. It is fastened with a rubber band, which keeps the match sticks in compact position. A detonating substance on one stick comes over a plain surface of the next, and just below on the adjacent stick the igniting material is placed, as shown in the smaller sketch. On pulling the match stick, the detonating compound passes over and rubs against the igniting substance of the adjacent stick. Ignition occurs under the frictional contact produced by the band, and when the match stick is rapidly pulled from the pack it is ready for use. The detonator and igniter are never in contact when within the accordion folds.

The possibility of lighting a match or fusee with one hand while the other is engaged is made easy by the simple mechanism illustrated in Fig. 4. The small section view shows a match in its inside position. The inner surface of one end of the open tube is coated with a surface of sand, glue, or other rubbing compound to ignite the match. The head end and most of the match is inclosed in the casing. Pressing or pushing the protruding end through the tube causes the head to come in contact with the frictional surface of the other end of the tube, where it is ignited and on passing out burns, as shown in the larger engraving. The invention is usable in rainy, windy, or stormy weather, and may be safely carried loosely in a pocket, pouch, or like receptacle.

Another safety match is presented in Fig. 5. It is practically the same as the preceding type. The end occupied by the head of the splint or stick is closed, and the flat extension affords a means for holding the sleeve or casing in the fingers. By closing the outer end fire is retained if the splint is not properly withdrawn. By pulling the splint suddenly from the sleeve an igniting compound of the former is brought into contact with the rubbing compound of the latter, and ignition takes place immediately. Two hands are required in the use of this invention.

A safety match has been invented having an incision nearly at its middle part. The stick will break on a line extending from the inner end of this incision across the match. The surface of the notch is covered with an igniting compound, and is shown in the bottom illustration of Fig. 6. The upper illustration of this figure presents the scratching of the match head on the igniting surface. In this improvement there is neither danger of accidental lighting nor chance of wear to the compound.

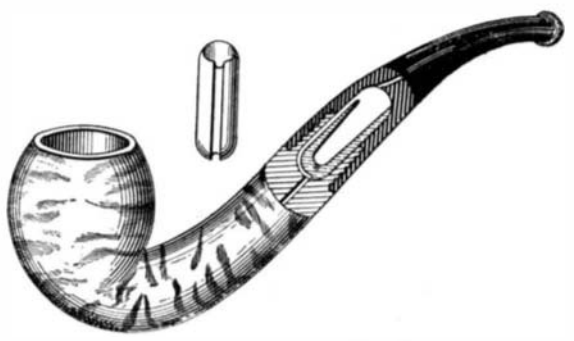
Swimming Appliance.—The accompanying engraving



AN ODD SWIMMING APPLIANCE.

illustrates an attachment which may be secured to the legs of a swimmer to assist him in propelling himself through the water with greater speed than can be accomplished by the use of the natural members of the body. The attachment consists of a pair of wings or blades secured by means of straps to the ankles and feet. The blades are so hinged as to fold when the leg is moved forward, but will straighten out when kicked backward and thus offer a large area of resistance, causing the swimmer to move forward rapidly. Aside from these main blades a series of smaller hinged blades are provided which are attached to straps secured to the legs. These blades are also arranged to open when the legs are moved backward, but fold back when the legs are drawn forward.

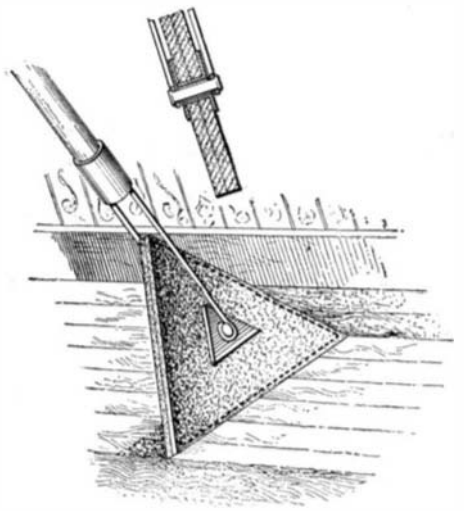
Tobacco Pipe.—Many inventions have been made with a view to preventing saliva from flowing down the



AN IMPROVED TOBACCO PIPE.

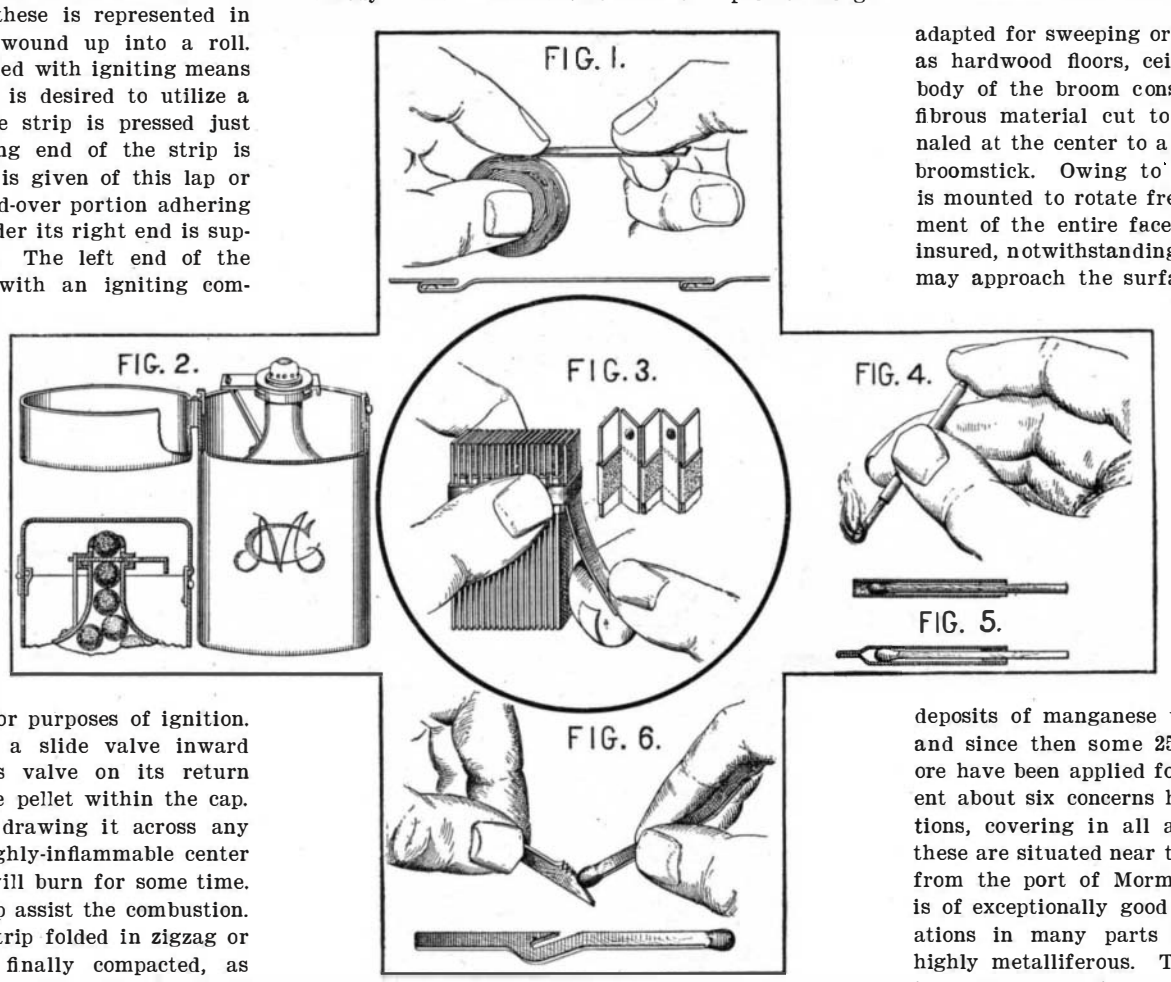
stem of a tobacco pipe and reaching the pipe bowl, and also to prevent the passage of nicotine up the stem to the mouth of the smoker. One of the latest of these inventions is illustrated herewith. The pipe is formed with a detachable mouthpiece, and between the two members an opening is formed in which a receptacle is adapted to closely fit. This receptacle is formed with a groove at its upper side, along which the smoke from the bowl may pass to the mouthpiece. The upper end of the receptacle is open and serves as a trap for the nicotine and saliva. Whenever desired, the mouthpiece may be quickly unscrewed from the bowl section and the receptacle removed and cleaned.

Broom for Cleaning Smooth Surfaces.—A novel broom has recently been invented which is particularly



BROOM FOR CLEANING SMOOTH SURFACES.

adapted for sweeping or cleaning smooth surfaces, such as hardwood floors, ceilings, walls or the like. The body of the broom consists of a number of layers of fibrous material cut to a triangular form, and journaled at the center to a yoke secured to the end of the broomstick. Owing to the fact that the broom body is mounted to rotate freely on its bearing, the engagement of the entire face of one side margin is always insured, notwithstanding the manner in which the body may approach the surface to be cleaned; for if upon bringing the broom against the surface one corner should strike first, the broom body would swing on its axis until the entire margin was brought squarely upon the surface. Owing to the fact that there are a number of sweeping faces to the body the life of the broom is greatly increased.



SOME NOVEL TYPES OF MATCHES.

The British consul at Goa, Portugal, reports that deposits of manganese were discovered early in 1906, and since then some 250 concessions for mining this ore have been applied for to the government. At present about six concerns have commenced mining operations, covering in all about twenty mines. Some of these are situated near tidal water and not many miles from the port of Mormugao. The ore in some cases is of exceptionally good quality. The geological formations in many parts of the country appear to be highly metalliferous. The restrictions regarding mining and prospecting are not onerous, and the taxes on mines and their output are at present light.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

PORTABLE DYNAMO.—G. A. ALLEN, Western Springs, Ill. By means of this improvement a device may be built of twice the capacity of any former construction without increasing the size of the armature-shaft or length of rack-bar. It reduces to a minimum, if not entirely obviates, all sparking at the brushes and secures a great improvement in smoothness of running. The device is capable of firing more than twice as many fuses as any machine of this type, but is easily transferred from place to place and operated by one man.

CIRCUIT-BREAKER FOR ELECTRICAL CONDUCTORS.—W. G. SHAW, White Plains, Md. In this patent the invention is an improvement in circuit-breakers for electrical conductors, and is particularly designed for use on overhead wires forming parts of a circuit. The stub-shafts are concentric and in alinement and form supports for the circuit making and breaking sections in the operation of the invention.

Of General Interest.

CAR.—F. A. BOOLE and L. D. STEPHENSON, Blaine, Wash. The invention has reference to cars, and especially to those for holding lumber in kilns during process of drying. Its principal objects are to provide such a car in which each piece of lumber will be separated from those adjacent to it by an air-space and which may be readily assembled or disassembled.

CORD OR STRING CUTTER.—A. F. HOFFMAN, Olean, Mo. The cutter comprises a handle having a reverse curve, the two parts of the handle being separated from each other to form a crook, a blade formed integrally with the body of the handle and in general alinement therewith, one edge of the blade being sharpened, and a curved and blunted point extended in general alinement with the blade.

TURPENTINE-BOX.—A. C. MCLEOD, Quitman, Ga. The invention comprises a box and a reinforcing-wire having a front portion wired to the upper edge of the front of the box and provided at its ends with rearwardly-projecting portions wired to the upper edges of the opposite ends of the box and extended rearwardly beyond the box to connect with a tree.

PNEUMATIC WATER-LIFT.—W. A. HARRIS and B. S. H. HARRIS, Greenville, S. C. In the present patent the invention is an improvement in pneumatic water-lifts, and has for its object to provide a novel construction by which the water may be elevated by pneumatic pressure and which may be utilized as a fire-extinguisher when it is desired.

HALF-TONE-PRINTING PLATE. — L. F. SMITH, El Paso, Ill. The object of the inventor is to successfully make half-tone plates without any expensive apparatus. Although for use in half-tone work, line-etching in zinc, brass, or other metals may be made as thin plates and mounted in the same way. The method of connecting the face-plate to the back is applicable to all kinds of printing-plates, engraved or chemically etched, of thin and flexible plates or thick and rigid ones, of a flat surface or a curved plane surface, and a wooden backing or a metal backing.

SHEET-METAL ROOFING.—D. J. WINN, Sumter, S. C. In this instance the invention consists in forming one of the side edges of the sheets with two additional folds arranged to form a return-bend over the ridges, so as to cover and protect the nails and giving a triple thickness of sheet metal over the ridges. The roofing-plates are folded in one piece and compactly nested for mutual protection and economic transportation.

CREOSOTE-TRAP.—E. C. COLE, Chicago, Ill. The invention is an improvement in stoves and ranges, and has for an object the provision of a novel means whereby to catch and retain creosote dropping from the smoke-pipe of a range. An important feature is a pocket or trap formed in the casting of the back flue and all dangers of leakage resulting from defective joints and the like are avoided.

DERRICK.—W. L. ALLAN, San Francisco, and W. T. PRICE, Ithaca, N. Y. The principal object of the invention is to construct a derrick which may be erected without the use of a gin-pole, and which is so formed as to allow of the topmast-sheave being placed close to the top of the mast, thus doing away with certain stresses set up in the mast when the sheave is placed in the usual position and also allowing the mast to be made lighter than heretofore.

AUTOMATIC SHUT-OFF FOR FLUIDS.—E. L. CRIDGE, Passaic, N. J. The improvement relates to valve mechanism, the more particular object being to provide a valve operated and controlled by means of pressure of a fluid passing through said valve, the arrangement being such that when the pressure of the fluid falls below a predetermined limit the valve closes and shuts off further flow of the fluid.

BELT-FASTENER. — P. TESSIER, Horace, N. D. This invention is an improved fastening means for connecting the ends of a power-belt, rendering the connection secure without injury to the normal strength of the material. Among the objects of the invention is to provide a device of this character which can be readily applied or removed when desired and which will act to hold the ends of the belt with greater security as the tension thereon is increased.

SPEED-INDICATOR.—J. T. F. CONTI, 195 Boulevard Pereire, Paris, France. This apparatus essentially comprises a receptacle having a central capacity connected with an upper lateral tubular or circular chamber and containing a heavy liquid, such as mercury, upon which rests a lighter liquid the level of which will depend upon the deformations of the liquid under the influence of the centrifugal power.

FLUE-CLEANER.—G. C. FRENCH, Chicago, Ill. The invention has reference to flue-cleaners, and has for its object to provide means adapted to readily and completely loosen and remove soot and scale from the inside of a boiler-tube without becoming clogged and consequently rendered more or less inoperative. The operation of the cleaner is continuous.

SEDIMENT-CATCHING POCKET FOR RECEPTACLES.—W. M. GILBERT, Conshohocken, Pa. The invention relates to certain improvements in dispensing-receptacles, and more particularly to means adapted to be inserted within or formed integral therewith whereby any sediment which settles to the bottom of the liquid may be caught and prevented from being dispensed with the main body of the liquid.

GRATE-BAR.—A. L. HOWARD, Vinton, La. The invention is especially useful in connection with devices adapted for the purpose of burning culm, sawdust, and the like. The object is to provide a device inexpensive to manufacture and which presents removable top sections which may be easily replaced from time to time as circumstances require.

FIREPROOF CONSTRUCTION FOR BUILDINGS.—J. JACOBS, Akron, Ohio. In the present patent the purpose of the inventor is the provision of an economic and effective fireproof construction for fire doors, shutters, and partitions, which construction combines lightness with strength and durability and is readily adaptable to any manner of building.

EYE-PROTECTOR.—E. MIROVITCH, 53 Rue Notre Dame de Lorette, Paris, France. The invention comprises eye-glasses or goggles for automobilists or others, having a double ventilating-tube and an extensible bridge-piece, the construction of the bridge comprising two semi-cylindrical stems adapted to work within a screw-threaded nut having right and left handed screw-threads adapted to engage corresponding threads on the ends of the respective stems. It relates to improvements in eye-protectors for which former Letters Patent of America were granted to Mr. Mirovitch.

SANITARY MOUTHPIECE-GUARD.—R. R. MACGILL, Baltimore, Md. The object in this case is to provide a simple and efficient device which will insure the user of the device protection against disease germs, and which permits the application of new disinfectant material for each user of the device without necessitating the removal of the same from the telephone.

SAFETY DEVICE FOR ELEVATORS.—W. LOWRY, Cowley, Alberta, Canada. The invention refers more especially to devices for elevators employed in coal and other mines, although applicable to elevators employed in other places. One of the principal objects is to provide devices of this kind of an embodiment to overcome disadvantages and objections encountered in the use of many other devices of the kind hitherto employed.

CRATE.—R. MORGAN, Ellsworth, Kan. Mr. Morgan's invention is an improvement in crates of the collapsible type. By the peculiar construction of the sides of the crate the said sides may be extended and contracted longitudinally during the folding and opening of the crate, the contraction of the sides permitting inward folding of the sides and ends without interfering with each other.

Hardware.

NUT-LOCK.—J. K. GOURDIN, Pineville, S. C. The invention secures a better spreading of a locking-key into spaces between a nut and bolt in order to lock said key in place when driven home. The key is of soft metal, and pressure applied, it spreads into the spaces in the threads of the bolt and nut and locks them against displacement. Means provide for increasing this locking effect. In compressing the key in the space between nut and bolt a punch may be placed against the outer end of the key when fitted in place and the punch hammered to force the soft-metal key between the bolt and key. A wrench applied with force cuts the soft-metal key and permits removal of the nut.

SNAP-HOOK.—J. C. WELCOME, SR., Burns, Ore. One purpose of the invention is to provide a hook particularly adapted for use in connection with harness, so constructed that all springs are dispensed with and so that even if the snap is closed it will automatically open when a ring or like object is passed to the bill of the hook and whereby the snap will be automatically closed by the entered object when within the bill, but that after the hook is engaged with an object it will not become disengaged until purposely released.

WRENCH.—A. S. MORANGE, Strattord, Conn. The invention is an improvement in wrenches having among other objects to provide a strong and compact adjustable wrench of simple construction in which all of the operating parts are completely inclosed, thereby presenting a neat outward appearance and protecting the adjusting means from the weather.

Heating and Lighting.

FLAME-SPREADER FOR OIL-BURNERS.—J. H. GREENHAGEN, Columbia City, Ore. The invention pertains its improvements in flame-spreaders for all burners used in railroad signal-lamps and the like, its object being to produce a spreader which is economical in the use of oil, and designed to properly spread the flame without causing smoke, and preventing accumulation of dirt in the spreader.

HEATING STOVE.—L. H. THURSTON, Belt, Mont. The improvement is in the nature of a new heating stove, applicable for heating stoves and furnaces of all kinds, and to which is given the name of "oxygen blast." It is designed to secure a more economical use of fuel, a thorough heating of the lower stratum of air in the room, and a perfect ventilation of the room with removal of foul air.

Household Utilities.

PLATE-LIFTER.—C. F. SMITH, New York, N. Y. In this patent the invention is an improved plate-lifter for carrying plates, lids, and other devices about in the kitchen, especially when in heated condition. The invention is primarily directed to a novel construction adapting the lifter to be adjusted with facility to suit plates, pans, etc., of varying diameter.

WINDOW-SHADE AND CURTAIN-SUPPORT.—J. L. SMITH, Eureka Springs, Ark. The object of the inventor is to provide means simple in construction and durable in use adapted to be readily applied to a window-casing and to permit a curtain or shade to be lowered from the top of a window and held adjusted in the desired position, so as to admit air and light from above the top of the curtain and shade and permit of readily cleaning the same.

BEDBUG-TRAP.—J. E. BRUNDIN, New York, N. Y. The device is intended to be employed in connection with a bed or bedding for the purpose of trapping bedbugs and such like insects or vermin. The principal object is to produce a trap which may be easily and quickly applied or set for the uses intended and which may be readily detached and emptied or discharged.

Machines and Mechanical Devices.

APPLIANCE FOR CORD AND ROPE MACHINES.—P. M. STEGMAIER, Plymouth, Mass. The appliance is applied in cord and rope machines for the purpose of smoothing and rendering uniform and compact the lay or twists of the strands of cord or rope as the latter leaves the forming device. It is adapted for all purposes of what are known as "fore-turn-tubes" and "after-turn-tubes," and may be disposed in either horizontal or vertical position, according to the character of the forming or laying devices of the cord or rope machine on which the same may be applied.

ATTACHMENT FOR LINOTYPE-MACHINES.—W. N. BOWMAN, Pierre, S. D. The device consists of a guard adapted to fill an open space at the top of the mold-slide, thus preventing metal from dropping in front of the ejector-blade, the guard end bearing against the periphery of the rim of a mold-wheel, so as to scrape therefrom all type-metal, and a wiper arranged in the path of the mold adapted to oil the walls of the mold-orifice, enabling the slug to be ejected and a perfect "lock-up" to be obtained between the mold and the spout of the melting pot, thereby preventing high slugs caused by metal adhering to the back of the mold.

PAPER-MAKING MACHINE.—W. H. HOFFMAN, Little Falls, N. Y. The invention pertains to cylinder and Fourdrinier machines; and its object is to provide improvements in machines whereby light-weight stock, such as used for making tissue and toilet paper is prevented from sticking and breaking while passing the press-rolls, thus producing a better quality of paper, increasing the capacity of the machine, and reducing waste of stock to a minimum.

CANDY-MACHINE.—Z. S. HOFFMAN, Newark, N. J. In this instance the improvements are in candy-machines of the type operating centrifugally to force out the melted sugar or other candy material in shreds or of a floss-like nature, the main object being to so construct the candy-head that the outlet may be readily adjusted as to size, thus providing for various sizes of shreds.

Railways and Their Accessories.

SLEEPER AND CONNECTION FOR RAILWAYS.—R. H. IRELAND, Newark, N. J. Among the objects in this invention is the provision for the securing of the rails without the use of spikes or like fastening devices and enabling the rails and sleepers to be assembled expeditiously without the necessity of gaging the distance between the rails, which is fixed and determined in the manufacture of the sleeper.

AUTOMATIC AND STEAM PIPE COUPLING.—W. F. THORNTON, JR., Germantown, Pa. An object of the inventor is to simplify the construction of this device, making it positive and perfect in action even when the coupling of the cars takes place under the most unfavorable circumstances, as when brought together on sharp curves or when the couplers of the cars stand at different heights; further, to provide for the connecting of the air and steam pipes of one of the improved automatic couplers with such pipes of an adjacent car when the latter is not thus provided.

RAIL-JOINT.—A. E. SPRATLEY, Monett, Mo. Among other objects in this case is to dispense with the use of bolts and other devices for positively connecting the rail ends together, and thereby admitting of the rails expanding independently of each other. The construction is such that the strength of the joint is materially increased and the ends of the rails supported in a way to prevent the constant pounding of the train-wheels depressing them at this point.

Pertaining to Recreation.

BAIT TRAP AND HOLDER.—V. LE BEAU, New Orleans, La. The object in this improvement is to provide means for storing food adapted to attract minnows, to hold the food compactly and in good condition so as not to be affected by the currents or when raising the trap out of the water, and also to provide means whereby the live bait is permitted to readily enter the trap and be retained.

Pertaining to Vehicles.

VEHICLE.—O. J. WIDMEIER, Sigel, Ill. In driving on country roads where they are bad it is inconvenient for a single-horse team to pass along by reason of the fact that most vehicles which pass are double-horse teams. Horses of the double teams wear two paths in the roadway, and the intermediate space becomes very rough, upon which space the horse, if it were a one-horse vehicle, must pass. The object is to provide a vehicle which will overcome this objection.

BOW-REST FOR VEHICLE.—J. H. SPRAGUE, Norwalk, Ohio. The invention relates to improvements in folding tops for automobiiles and other vehicles, and more particularly to means for spacing the bows of said tops and holding them in definite position in relation to each other when the top is folded back, said means being so constructed that all chafing and wearing of the bows or cover is prevented. The bow-rests are so constructed as to prevent all rattling or jarring of adjacent parts.

AUTO SNOW-CAR.—J. SHERWOOD, Lake, Idaho. In carrying out his invention, Mr. Sherwood provides a main frame mounted on runners and carrying a suitable motor, together with a propeller connected with the said main frame and arranged to be operated by the motor mechanism on the main frame to advance the car, and also to be heated from the said motor mechanism, whereby to keep the surface of the propeller clear of accumulations of snow, so it will be in operative condition at all times when desired.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10410) A. C. M. asks: I am told that some ten years ago a method was described in the SCIENTIFIC AMERICAN by which a man can obtain power by looking at some particular part of his face through the mirror. This power enables him to get rid of his own diseases and to cure certain diseases in other persons by a method called suggestive treatment. This treatment, I am told, is also called biology or telepathy. The particular part of the face referred to has been pointed out to me, but I want to have full information on the subject, and shall be very glad to obtain, if possible, spare copies of the SCIENTIFIC AMERICAN which contained the suggestions referred to above, or any books dealing with the subject of obtaining power by this or any other means. I shall also feel very much obliged if you would kindly let me know the names and addresses of the persons practising this treatment, to whom I may refer for the solution of my difficulties. A. We have no information regarding a method of curing diseases by looking at ourselves in a mirror. We wish it were in our power to do so. It would be vastly easier than to take medicine.

But we shall stick to the old way for the present. We do not think this method of treating disease is described in any scientific work.

(10411) J. W. asks: If you have a book that tells how the distance from the earth to the sun is ascertained, let me know. Could you give me the formula in trigonometry for finding the side distance or hours of the sun dial? A. The distance of the earth from the sun was ascertained first by astronomers by observations upon the transit of Venus. The solar parallax will give the result if it can be found with sufficient accuracy. The best method for finding it is by measuring the velocity of light, which multiplied by 499 gives the distance of the earth from the sun. You will find most of these processes given in text-books of astronomy. We can send Moulton's for $1.50, and Young's "General Astronomy" for $3. The formula for a sun dial which employs a horizontal surface upon which to cast the shadow of a style, or plate, is tang. angle with north and south line equals tang. 15 deg. times sin. lat. for 1 P. M. and 11 A. M. tang. angle for 2 hrs. 10 A. M. and 2 P. M. equals tang. 30 deg. times sin. lat. and so forth till the angle for the longest day in summer at your place is reached.

(10412) S. B. M. asks: Will you kindly settle the following arguments? Practically the same principle is involved in all three, and of course the velocity of the cannon ball in the first is absurdly small, but that is granted for the sake of argument. I. A train is running eastward at a speed of 100 miles an hour. Mounted on the front of this train is a cannon. From the cannon is fired a projectile with a velocity of one hundred miles an hour westward: i.e., in a direction opposite to the motion of the train: A holds: 1. That the projectile will move over the top of the train with a velocity of 100 miles an hour. 2. That its velocity with regard to the ground is nil; i.e., through space it has no velocity. 3. That a rifle ball will reach the ground in just as short a length of time when fired at a high velocity as if it were dropped from the muzzle of the gun with no lateral velocity, granted of course that the ground is level and the bore of the gun is parallel to the ground. B holds: 1. That the projectile will move over the top of the train at the rate of 200 miles an hour. 2. That with regard to the ground it has a velocity of 100 miles an hour westward. 3. That this is not true. A. In your various propositions regarding relative motion, the one whom you designate as A is right and B is wrong. Such problems are applications of Newton's Three Laws of Motion, or rather of the first and second laws. These laws are to be found in all school textbooks of physics. The cannon mounted upon the train which is running 100 miles an hour is carried eastward by the train with a velocity of 100 miles an hour, and sends its projectile westward with a velocity of 100 miles an hour. It should be plain that a ball which moves east and at the same time west with the same velocity will be at rest with reference to the earth below it. The train moves away under it. The ball would drop vertically upon the roof of the train, or upon the earth below from the muzzle of the gun, if the train could run from under it before it had time to fall upon the roof. The rifle ball shot horizontally will fall toward the ground as really and with the same velocity as if it were dropped vertically. See Newton's Second Law. Gravitation produces its effect, whether it acts at the same time with other forces or acts alone. This is the reason why a ball which is projected upward returns to the earth again. All objects not supported fall toward the center of the earth in exactly the same manner, since gravity produces its effect upon all alike. It matters not how they are moving under the action of other forces. II. An elevator falls down a shaft at the rate of 50 feet per minute; a man drops after it at the rate of 60 feet per minute. A holds that the man will strike the elevator with the same force as if the elevator were stationary and he were dropping 10 feet per minute. B holds that he will strike it with less force. A. A man who strikes an elevator which is moving 10 feet per minute slower than he moves will strike it with a velocity of 10 feet per minute, and give a blow proportional to his weight and his velocity. III. The same thing as II. (a) A train is moving at the rate of 30 miles an hour; on the same track a train is following at 40 miles an hour; (b) they are moving at the same speeds on parallel tracks. A holds that (a) the second train will strike the first with the same velocity or force as though the first were standing still and the second struck it going at the rate of 10 miles an hour; (b) that the second train will pass the first at the rate of 10 miles an hour—will take as long to pass it as though it were standing still and the second going at 10 miles an hour. B holds (a) that the second train will strike with less force and (b) that it will take longer to pass the first train. A. The swifter train will pass the slower train as if it were standing still and the swifter had a velocity equal to 10 miles per hour, the difference of the two velocities. All these answers are based upon the supposition that the resistance of the air is excluded from the problem, as is usually done in such cases. This is not necessary, however, in these answers, since it is stated in the questions that a certain definite velocity is attained, the resistance of the air being one of the elements in attaining the velocity.

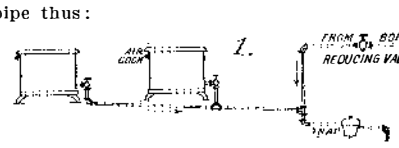
(10413) H. F. says: Concerning the earthquake reported, was the recent disturbance in Kingston predicted by reliable scientists, and can such disturbances be prognosticated to any degree of accuracy? A. Earthquakes have not been successfully predicted, nor does it seem probable that they ever can be predicted.

(10414) J. W. K. says: I hereby take the liberty of asking you to settle an argument. I claim pure distilled water is a nonconductor of electricity, B claims it is a good conductor. Which is the best insulator of the following—glass, pure water, oil, rubber, wood (dry), shellac, and in what order do they stand? What would the resistance of a column of pure water be if the column were 1-16 inch in diameter and 10 feet long, also the same column of silver? Please state the resistance in ohms. A. If the conductivity of annealed copper is taken as 100, the conductivity of annealed silver is 105, and of hard-drawn silver is 98.1. On the same scale the conductivity of pure water is less than one-millionth (0.000001) and that of glass less than one-billionth (0.000000001). Pure water is classed with insulators, but pure water does not exist in nature. The resistance of a silver wire, annealed, 0.001 inch in diameter and 1 foot long, at the freezing point of water, is 8.781 ohms; and that of the same wire hard drawn, under the same conditions, is 9.538 ohms. From these figures you can calculate the resistance of the wire you wish to use. The resistance of the column of pure water of same size and under the same conditions would be less than one-millionth as much. We leave the calculations to you. The order of the insulators about which you inquire as given by Foster in his "Pocket Book" is pure water, olive oil, paraffine oil, glass, gutta percha, shellac. We can send you the book for $5.

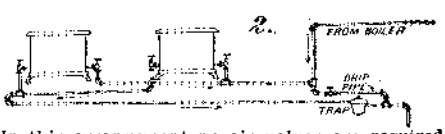
(10415) A. O. S. says: What is your idea, or the idea of scientific men of to-day, as to the condition of the ultra space as regards temperature? In other words, if a thermometer were placed far and away beyond the effects of gravitation and radiation of the entire stellar universe or ultra space, what would it register? Would it be what we call absolute zero, or in other words total absence of heat, and if so, why? A. It is the opinion of scientists that the temperature of space is absolute zero. The simple reason for this is that there is nothing there to intercept the waves of radiant energy and thus transform them into heat.

(10416) Several valued correspondents have written us, calling attention to the error of omission on the part of the types in an answer to Query 10342. Not all of the criticisms were kind, some were unjust, and some as erroneous at least as the original incomplete answer. In another note we have completed the answer as it should have appeared in the original issue, and have said all it seems necessary to say about it. We may now, however, point out the curious failure in argument by several in reasoning that whatever would be true of two balls of metal falling a short distance in air would also be true for any distance and for balls of any materials whatever. They argue even to the case of lead and hydrogen, in which of course a most absurd conclusion would result. Lead is not far from 9,000 times as heavy bulk for bulk as air, and aluminium is about 2,000 times as heavy as air. These in a fall of a moderate distance will fall equally fast. As we have before stated, the fall will not differ appreciably for distances up to 100 feet or more. We have not experimented on this matter, but take the statements of good authorities. Galileo experimented with 1-pound and 10-pound balls of lead and dropped them from the Leaning Tower of Pisa, height 179 feet, and found that they fell practically together. A lead ball weighs four times as much as an aluminium ball of same size. This difference is small as compared with the difference between these weights and that of the displaced air. For low velocities such as are acquired in a fall of 100 feet these two balls will be about equally able to overcome the resistance of the air, and will doubtless reach the ground very nearly together.

(10417) L. H. P. writes: Referring to the question asked by H. W. S., No. 10192, in your paper of November 10, 1906, page 351: Neither system of radiator connections will work at 80 pounds pressure. The diagram No. 1 would work at a reduced pressure, say 5 pounds, provided the pipe was of the proper size, and the trap connected with the down pipe thus:



Your diagram No. 2 will not work, as the return of the first radiator will stop the circulation of the second. It should be run thus:



In this arrangement no air valves are required if any ordinary Nason or pot trap is used. In both diagrams shown by you, the air valves are at the wrong end of the radiators. A. We thank you for calling our attention to another way of arranging the piping of the radiators. Both systems, as you describe them, would, we believe, work satisfactorily. Both systems shown in our sketches would work at 80 pounds pressure if the piping were of proper size and properly pitched. We understand, of course, that a much lower pressure, say 5 pounds, would be much preferable, but that was not the pressure which was specified in the letter we were answering. We therefore did not refer to it. The location of the air valve depends on the character of the radiator. On most of the common radiators the air valves are located as you indicate them.

(10418) J. G. T., Cincinnati, Ohio, is informed that if he sends his name his queries can be answered. See first notice in Query column each week.

(10419) M. W. P. writes: Our teacher has taken the position that a circle is a polygon. I would be pleased to have your opinion on the matter and also a demonstration in proof, for she will not receive any proof that I have been able to find. A. We are not able to tell from your letter whether you agree with your teacher that a circle is a polygon or not. If you do not agree with her we are sorry for you, since she is entirely right. Every mathematical student of any advancement knows that the circle is regarded by all mathematicians as a polygon of an infinite number of sides. The fact that a polygon may be inscribed in a circle and another may be circumscribed about the same circle which shall differ from the circle by less than any assignable quantity is proof of the point in question.

(10420) L. T. F. asks: As a reader of your paper for thirty-five years I would ask you to give the following information through your journal. This morning, about 5 A. M., we discovered smoke in our house. After investigating I found a bunch of rags on fire on a shelf. It was a glowing mass of fire about the size of a cocoanut, but no blaze. I found on further investigating that this rag had been saturated with furniture polish during the previous day, composed of linseed oil, turpentine, and varnish. I would like to know if it is possible for spontaneous combustion to take place on an open shelf in twelve hours' time? If so, there is a new danger for fire not thought of by the average housekeeper. A. A rag saturated with a mixture such as you describe is a very dangerous thing to leave lying around the house. The average housekeeper should not run such a risk of a fire. Many cases like this occur every year.

(10421) D. D. A. asks: 1. How can I make dry batteries? That is, what shall I fill them with? A. Dry cells are filled with a solution of ammonium chloride in water. Other materials are added to make a suitable paste. The carbons are packed with manganese dioxide and graphite. The process is given in our Supplements Nos. 1383 and 1387, price ten cents each, much more fully than can be given in a letter. 2. I have a small electric motor; the armature has three poles, the brushes are flat copper. Can I change it into a dynamo? Please give directions for doing so, if possible. A. Many small motors will not generate as dynamos, since they cannot build up a field of sufficient strength. You can find out about yours by trying it. Should you not succeed, you can then disconnect the field wires and use a battery in the field circuit to magnetize the field. It will then be separately excited, and will generate a current.

(10422) L. M. F. asks: I have a ground circuit telegraph line one-half mile long; two 20-ohm instruments on line. At one end have two 5 x 7 and one 6 x 8, at the other end one 5 x 7 and one 6 x 8 gravity batteries. Have glass insulators for line wire; do not know if line wire is steel or iron. Batteries will not work line, will work on short circuit. Have batteries connected, the positive pole to the negative pole of the other; also have them connected from one end of line to the other in like manner. I have worked line with an addition (to the present batteries) of twelve dry cells. I have a bell which one dry cell will ring, my gravity batteries will not. I have the copper covered with blue vitriol. The crowfeet are covered with a black substance. Batteries have been charged for two weeks. Are my batteries weak? Is my line the fault to a certain extent? How many gravity batteries will it take to run this line with 20-ohm instruments when line is in working order? A. Your trouble with the telegraph line may be due to one or more of several causes. The joints of the wires of the line may not be good. The ground connections may be bad. The battery may not be connected in series at the two ends, so that one part of the battery opposes the other part. The battery may not be powerful enough for a good line, and if there is any fault in the line the battery will of course not be powerful enough for a poor line. It is not possible for us to tell which of these causes is the source of your trouble. One dry cell may ring a bell when a far better gravity cell will not. The dry cell has 1.5 volts, and the gravity cell has only 1 volt at its best. But the gravity cell with its 1 volt will work right along for months on a telegraph line, while the dry cell will be run out in a short time. The black, or rather brown, dirt on the gravity zincs does not diminish to any extent the force of the cell. It is well enough to take the zincs out and scrape off once in a while. If you can find no other fault in your line, you would do well to put on more cells.

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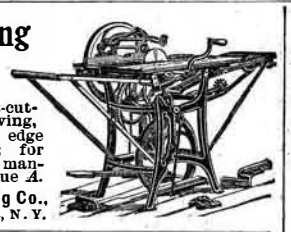

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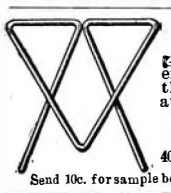

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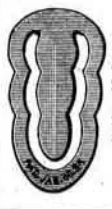

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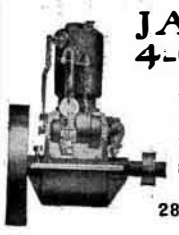

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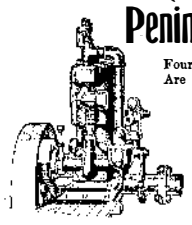

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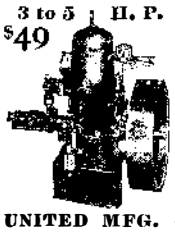

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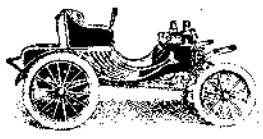

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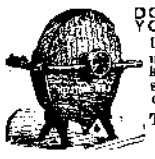

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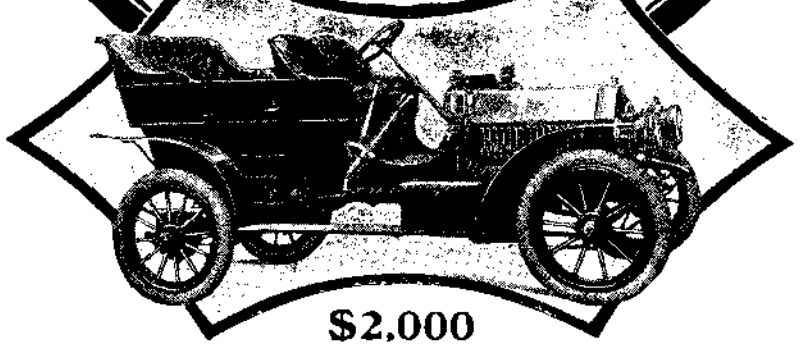

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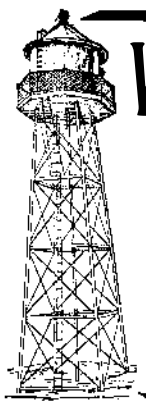
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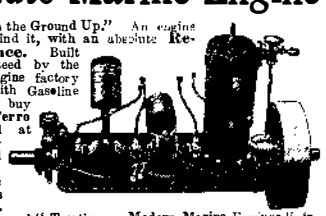
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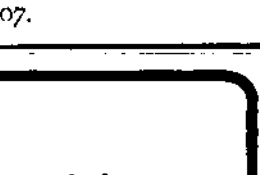
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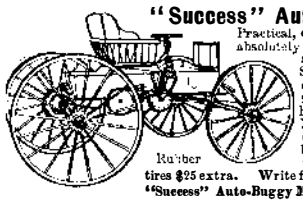
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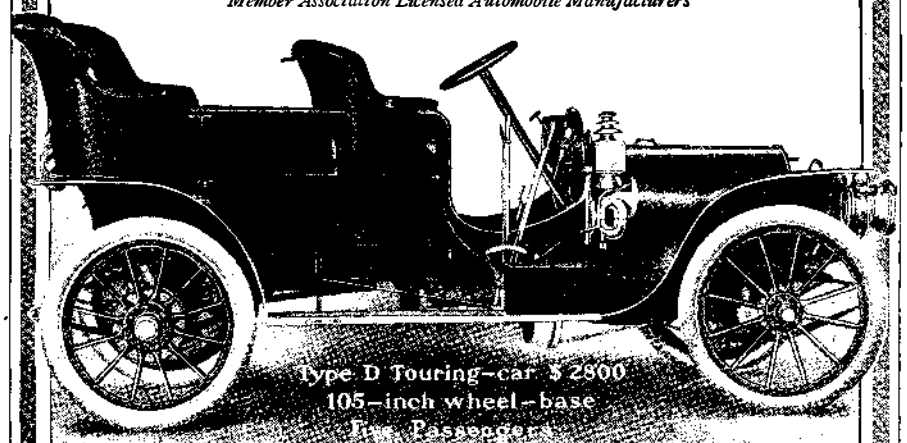

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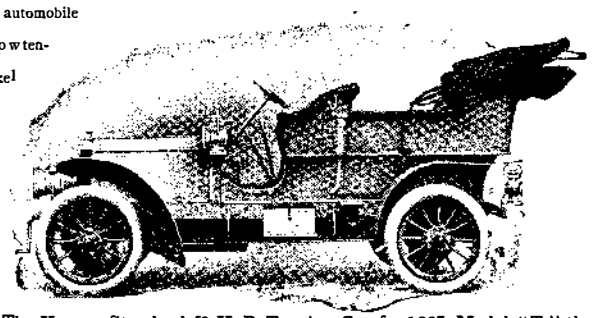

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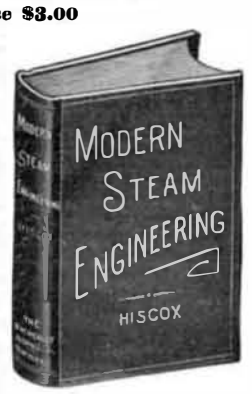

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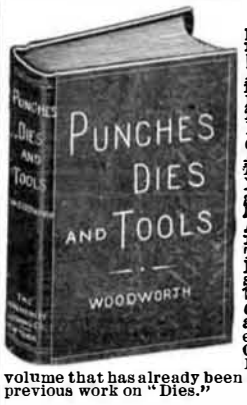

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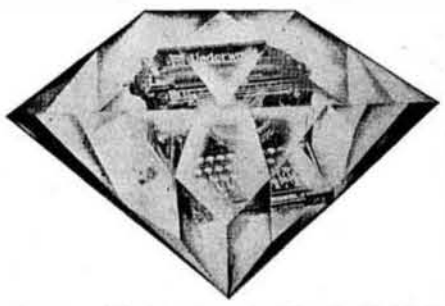

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Remedy for certain diseases and injuries, Hall & Ruckel	61,029
Remedy for diseases of the blood, R. W. Adams	61,016
Remedy for stomach ailments, F. R. Greene	61,027
Remedy for treatment of grip, etc., Porter Medicine Co.	61,015
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Sewing machines, attachments, stands, tables, and covers, White Sewing Machine Co.	60,989
Shaving cream, Royal Cream Co.	61,018
Shells for explosive projectiles, cast steel, Taylor Iron & Steel Co.	60,946
Sherry, J. Wile, Sons & Co.	60,951
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Soap, Southern Cotton Oil Co.	60,966
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"Ginseng," for beverages, Ginseng Products Co.	13,376
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"Recordite," for a preparation for cleaning, preserving, polishing, and lubricating disk talking machine records, J. A. Manahan	13,383
"Star Hair Tonic and Dandruff Cure," for a hair tonic and dandruff cure, Star Toilet Co.	13,381
"Sun Bleach," for cotton piece goods, Burton Bros. & Co.	13,384
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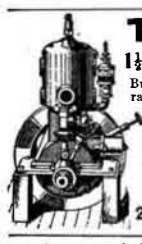

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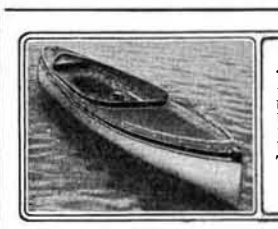

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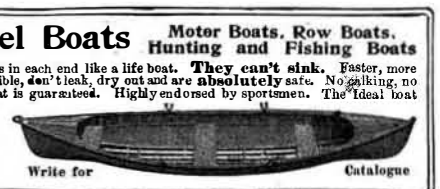

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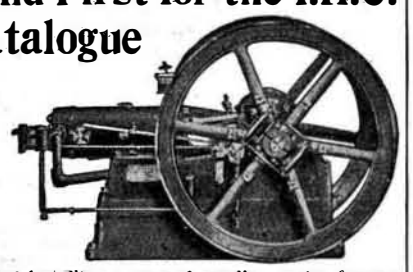

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